Engineering Lit

The Engineer.

SEP 4 1930

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OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CL.—No. 3893] LONDON: FRIDAY EVENING, AUGUST 22, 1930 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director of Army CONTRACTS invites TENDERS for return on 29th September, 1930, for the PURCHASE of a LARGE QUANTITY of LIFTING APPARATUS, including :—

TACKLE BLOCKS, LIFTING JACKS, TRIANGLE GYNS, WINCHES, &c.

Tender forms with full particulars may be obtained on application to the DIRECTOR OF army CONTRACTS, War Office (D.C. 4), Caxton House West, Tothill-street, Westminster, London, S.W. 1. 5617

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—TWIN-SCREW, OIL-BURNING, SEA-GOING TUG, length about 110ft.
SCHEDULE 2.—2983 VOLUTE DRAW SPRINGS.
SCHEDULE 3.—1071 STEEL TYRES for LOCOMOTIVES.
SCHEDULE 4.—441 CRANK and STRAIGHT AXLES for LOCOMOTIVES.
SCHEDULE 5.—46 COPPER PLATES for LOCOMOTIVES.
SCHEDULE 6.—46,710 STEEL BOILER TUBES, &c., for LOCOMOTIVES.
SCHEDULE 7.—398 VACUUM CYLINDERS for LOCOMOTIVES.
SCHEDULE 8.—MILD STEEL BUFFERS and SPARE PARTS for LOCOMOTIVES.

Tenders due :—
Schedule 1, 12th September, 1930.
Schedules 2 to 8, 17th September, 1930.
Forms of Tender available from the above at a fee of 5s. (which will not be returned) for each Schedule. 5645

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/2156.—DEPUTY ENGINEER and MANAGER REQUIRED for the Kano Water and Electric Light Schemes, NIGERIA, for a tour of 12 to 18 months' service and possible extension. Salary £900 a year, plus £96 a year duty pay. Free quarters and passages ; liberal leave on full salary. Candidates, not over 40 years of age, must be Corporate Members of the Institutions of Civil and Water Engineers, with at least eight years' Engineering and Administrative experience, apart from pupilage or equivalent training ; preferably with a Water Company and where water is obtained by electrically operated borehole pumps.

M/2348.—ASSISTANT ROADS ENGINEERS REQUIRED by the GOVERNMENT of NIGERIA for the Public Works Department, for two tours of 12 to 18 months' service and possible extension. Salary £480 for three years and then £510, rising to £720 a year by annual increments of £30, and thence rising to £920 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, 25-35 years of age, preferably should have passed Sections A and B of the examinations qualifying for the A.M.I.C.E. Diploma or possess professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations. Should possess experience of Road and Bridge or similar Construction, Surveying and Levelling, and be competent to set out and supervise work and control labour.

M/2167.—WATER ENGINEER REQUIRED for the Kano Water and Electric Light Schemes, NIGERIA, for a tour of 12 to 18 months' service and possible extension. Salary £600 a year ; outfit allowance of £60 on first appointment ; free quarters and passages, and liberal leave on full salary. Candidates, 25 to 35 years of age, must be Corporate Members of the Institution of Civil Engineers, have had at least three years' experience, apart from pupilage or equivalent training, of the Construction and Maintenance of Municipal or Company Waterworks undertakings, preferably, though not essentially, Pumping Station Work.

M/2407.—ASSISTANT MARINE ENGINEER DRAUGHTSMAN REQUIRED by the SINGAPORE HARBOUR BOARD, for three years' service and possible extension. Salary 400 dollars, rising to 450 dollars a month by annual increments of 25 dollars a month. Free passages. Candidates, 25 to 30 years of age, preferably unmarried, must have a first-class general knowledge of the Design and Construction of all classes of Marine Engines, Boilers, Auxiliaries and Machinery.

M/2398.—ASSISTANT ENGINEER (ROADS) REQUIRED by the Public Works Department of the GOVERNMENT of CYPRUS, for four years' service. Free passages and liberal leave. Salary £600 a year. Candidates, 30 to 40 years of age, should be A.M.I.C.E., or have passed the Testamur Examination of the Institution of Municipal and County Engineers. Should have had Municipal Experience and a thorough practical knowledge of the Construction and Maintenance of Water-bound Surface-sealed and Tarmacadam Roads, and have a general knowledge of Building and Construction Work. Must be capable of Assisting Divisional Engineer in the general work of a division, and particularly in the Supervision of the Reconstruction of about 300 miles of Roads in Water-bound Macadam and Tarmacadam, under the Road Scheme. Must be capable, if required, to Take Complete Charge of a Section of the Division. Candidates with a knowledge of the modern Greek language preferred.

M/1895.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of KENYA COLONY for the Hydraulic Branch of the Public Works Department, for a tour of 20 to 30 months' service and possible extension. Salary £480, rising to £600 a year by annual increments of £30, and thence rising to £720 a year by annual increments of £40. Free quarters and passages and liberal leave on full salary. Candidates, age 25 to 35 years of age, must have passed Sections A and B of the Examinations to qualify for the A.M.I.C.E. Diploma, or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations. Must have specialised in Hydraulic Engineering, both theoretical and practical, and should have had some experience in Hydrometric Work. Must be capable of Computing the Flows of Rivers and Streams, Hydrographic Surveys, and Inspections of the Water Resources of the Colony, and must be able to assist in the Administration of the Water Law, the Design of Hydraulic Structures, Water Supplies and Drainage Projects, &c.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 5646

The Engineer

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PUBLIC NOTICES

Air Ministry. APPLICATIONS are INVITED for PERMANENT (PENSIONABLE) APPOINTMENTS as ASSISTANT CIVIL ENGINEERS.

Candidates must be between 25 and 30 years of age on the 10th September, 1930 ; those who have served or are serving in the Navy, Army or Air Force may deduct from their actual age, for this purpose, any time during which they have so served, but not exceeding 5 years.

A candidate must be either :—
(i) A corporate member of the Institution of Civil Engineers ;
(ii) A corporate member of the Royal Institute of British Architects ;
(iii) A corporate member of the Institution of Municipal and County Engineers ;
(iv) A person qualified to become a corporate member of the Institution of Civil Engineers on attaining the prescribed age ;
(v) A holder of a Degree in Engineering or an equivalent Diploma ;
(vi) A person who has held a commission in the Royal Engineers or an appointment in civil engineering under the British or Indian Government or a Dominion or Colonial Government and has been precluded by such employment from obtaining any of the above qualifications.

He must also have served for two years in an engineering firm of good standing or on the engineering staff of a Government or large Municipal Department or in the Royal Engineers and have there gained experience in civil engineering, both in the drawing-office and on important engineering works.

Successful candidates will serve on probation for two years ; they will be liable to serve at foreign stations for limited tours of duty.

The commencing salary will be £250 p.a. on the scale £250-15-£450 plus Civil Service bonus, which is £103 on a salary of £250 p.a., but which is subject to periodical revision. There are good prospects of promotion to higher posts.

Copies of regulations and forms of application may be obtained from the SECRETARY (W.B. 5), Air Ministry, Adastral House, Kingsway, London, W.C. 2 ; the form of application must be returned to reach that office not later than the 10th September, 1930. 5607

WANTED, REPRESENTATIVE FOR SCOTLAND.—Old-established Machine Tool Makers REQUIRE Part-time REPRESENTATIVE (resident Glasgow or Edinburgh), with a knowledge of the trade, on commission and expenses basis.
Address, P164, The Engineer Office. P164 A

PUBLIC NOTICES

Air Ministry. APPLICATIONS are INVITED for PERMANENT (PENSIONABLE) APPOINTMENTS as ASSISTANT MECHANICAL and ELECTRICAL ENGINEERS.

Candidates must be between 25 and 30 years of age on the 10th September, 1930 ; those who have served or are serving in the Navy, Army or Air Force may deduct from their actual age, for this purpose, any time during which they have so served, but not exceeding 5 years.

A candidate must be either :—
(i) A corporate member or a person qualified on attaining the prescribed age to become a corporate member of the Institution of Civil Engineers, having taken electricity and heat engines in Section B of the Associate Membership Examination ;
(ii) A corporate member of the Institution of Electrical Engineers ;
(iii) A holder of a Degree in Engineering, obtained on electrical and mechanical work, or an equivalent Diploma. He must also have served for three years in an engineering firm of good standing and there have gained experience in both electrical and mechanical engineering.

Successful candidates will serve on probation for two years ; they will be liable to serve at foreign stations for limited tours of duty.

The commencing salary will be £250 p.a. on the scale £250-15-£450 plus Civil Service bonus, which is £103 on a salary of £250 p.a., but which is subject to periodical revision. There are good prospects of promotion to higher posts.

Copies of regulations and forms of application may be obtained from the SECRETARY (W.B. 5), Air Ministry, Adastral House, Kingsway, London, W.C. 2 ; the form of application must be returned to reach that office not later than the 10th September, 1930. 5608

University of Manchester.
DEPARTMENT OF ELECTRICAL ENGINEERING.
DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

Full particulars of these Courses will be forwarded on application to the REGISTRAR.
The SESSION COMMENCES on THURSDAY, OCTOBER 2nd. 5579

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that SWENSON EVAPORATOR COMPANY, of 15647, Lathrope-avenue, Harvey, State of Illinois, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 321,698 granted to Alfred Ernest White for an invention entitled "Improvements in Methods of and Means for Evaporation or Distillation."

Particulars of the proposed Amendment were set forth in No. 2168 of "The Illustrated Official Journal (Patents)" published on August 7th, 1930.

Any person or persons may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.

W. S. JARRATT,
5614 Comptroller-General.

Armstrong College.
NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
4724 Newcastle-upon-Tyne.

Bradford Education Committee
TECHNICAL COLLEGE, BRADFORD.

FULL-TIME DAY COURSES are arranged to meet the needs of Students wishing to present themselves for the DEGREE EXAMINATIONS of the LONDON UNIVERSITY in—

MECHANICAL ENGINEERING,
CIVIL ENGINEERING,
ELECTRICAL ENGINEERING.

Further particulars and prospectuses may be obtained on application to the PRINCIPAL, Technical College, Bradford. 5443

University of Manchester.
PHYSICS DEPARTMENT.

Full particulars of the LECTURES and LABORATORY COURSES in PHYSICS, preparing for both the Ordinary and Honours Degrees will be forwarded on application to the REGISTRAR.
The SESSION COMMENCES on THURSDAY, OCTOBER 2nd. 5578

County Borough of Croydon.
EDUCATION COMMITTEE.

TEACHERS are REQUIRED in the following subjects, evening instruction 7.30-9.30, in the Mechanical Engineering Department of the Croydon Polytechnic for next Winter Session, commencing September 22nd.

First Year—ENGINEERING DRAWING, Fridays.
Second Year—ENGINEERING SCIENCE LABORATORY (HEAT, ELECTRICITY and MAGNETISM).
Third Year—ENGINEERING SCIENCE LABORATORY (MECHANICS and HYDROSTATICS).

The fees vary from 15s. per evening of two hours for the lowest appointments to 18s. for the highest, according to qualifications.

Applications, giving particulars of age, education, practical training, experience, present appointment, and residence, should be addressed to the PRINCIPAL, Central Polytechnic, Croydon.

R. B. MORGAN,
Education Officer.
Education Office,
Katharine-street. 5606

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PUBLIC NOTICES

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, are arranged for the Engineering Degrees of the University of London and for the Diplomas and Certificate of the College.

POST-GRADUATE COURSES in CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING are also provided.

HEADS OF DEPARTMENTS:

Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering (Dean).
C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.
Professor J. K. CATTERSON-SMITH, M.Eng., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer in Electrical Engineering.
Professor G. COOK, D.Sc., M.I. Mech. E., M. Inst. C.E., Mechanical Engineering.
S. J. DAVIES, M.Sc., Ph.D., M.I. Mech. E., Reader in Mechanical Engineering.
H. W. CREMER, M.Sc., F.I.C., M.I. Chem. E., Chemical Engineering.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the four Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 5448

The Polytechnic, Regent

STREET, W. 1.
SCHOOL OF ENGINEERING.

President of the School: The Hon. Sir CHARLES PARSONS, O.M., K.C.B., M.A., LL.D., D.Sc., F.R.S.
Head of the School: PHILIP KEMP, M.Sc. Tech., M.I.E.E., A.I. Mech. E., Assoc. A.I.E.E.
Head of Mechanical Engineering Dept.: R. F. THOMPSON, B.Sc. Hons. (Eng.), M.I. Mar. E., A.M.I. Mech. E.

The DAY DEPARTMENT REOPENS on SEPTEMBER 16th, 1930. Entrance Examination commences 8th September, at 9.30 a.m.

Three-year DIPLOMA COURSES in
MECHANICAL ENGINEERING.
STRUCTURAL ENGINEERING.
ELECTRICAL ENGINEERING.
AUTOMOBILE ENGINEERING.

Practice in the Laboratories, Drawing-office, Workshop, and Field.
Fee, 21 guineas per annum.
The EVENING DEPARTMENT REOPENS on SEPTEMBER 22nd, 1930. Students enrolled from 15th September, 1930.
The Day and Evening Courses are recognised for the National Diplomas and Certificates awarded by the Institutions of Mechanical and Electrical Engineers in conjunction with the Board of Education.
Prospectus free on application to the DIRECTOR OF EDUCATION. 5615

The Royal Technical College,

GLASGOW.

DEPARTMENTS OF ENGINEERING.

MECHANICS AND MECHANICAL ENGINEERING:
Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.
Associate Professor WILLIAM KERR, Ph.D., A.E.T.C., M.I. Mech. E.
ELECTRICAL ENGINEERING:
Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
CIVIL ENGINEERING:
Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
MINING ENGINEERING:
Professor DANIEL BURNS, M. Inst. M.E.
CHEMICAL ENGINEERING:
Professor of Technical Chemistry: THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.

Complete courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.
Composition fee, 25 guineas per annum.
SESSION 1930-31 BEGINS on TUESDAY, SEPTEMBER 23rd.
Calendar, by post 3s., and prospectus, gratis, may be obtained on application to the SECRETARY 5360

University of London, University College.

FACULTY OF ENGINEERING.
SESSION 1930-31.

Dean and Director of the Engineering Laboratories: E. G. COKER, M.A., D.Sc., M. Inst. C.E., F.R.S., Kennedy Professor of Civil and Mechanical Engineering.
Vice-Dean: M. T. M. ORMSBY, M. Inst. C.E.I., Edwin Chadwick Professor of Municipal Engineering and Hygiene.
Fender Professor of Electrical Engineering: W. C. CLINTON, B.Sc., M. Inst. E.E.

THE SESSION BEGINS
ON MONDAY, 6th OCTOBER.

The Faculty of Engineering provides a system of training in the application of scientific principles to professional and industrial purposes.
The DEGREE and DIPLOMA COURSES lead to the B.Sc. Degree in Engineering and the College Engineering Diploma.
There are SPECIAL COURSES for students who have already undergone a partial training elsewhere, and who have attained a sufficient standard, leading to a General Certificate of Engineering.
Graduates of Science or Engineering, or students who have done work equivalent to a Degree, may be admitted to special courses of study or to prosecute original research.
CERTAIN EXEMPTIONS are granted by the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Institution of Structural Engineers, and the Royal Sanitary Institute to students who have obtained certain qualifications at the College.
BUILDINGS AND EQUIPMENT.—Under the recent scheme of development about £58,000 has been expended in buildings and equipment in order to increase the existing facilities and to make the Engineering Laboratories thoroughly up to date.
The new buildings include the Cowdray Laboratory of Civil and Mechanical Engineering, the Charles Hawksley Hydraulic Laboratory, a Machine Tools Workshop, and the Edwin Chadwick Laboratory of Municipal Engineering and Hygiene.
Intending students should communicate with the undersigned, sending at the time a full statement of their previous training.
C. O. G. DOUIE, Secretary.
University College, London, Gower-street, W.C. 1. 5616

Gears
See large advertisement next week.
The Power Plant Co. Ltd.
WEST DRAYTON · MIDDLESEX

PUBLIC NOTICES

Bombay, Baroda and Central

INDIA RAILWAY CO.

The Directors are prepared to receive up to Noon on Friday, 5th September, TENDERS for the SUPPLY of:—
STEEL MATERIAL (PLATES, BOILER and ORDINARY QUALITY).
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion, 91, Petty France, Westminster, S.W. 1.
18th August, 1930. 5639

Borough of Bangor (County

DOWN, IRELAND).
MAIN DRAINAGE, CONTRACT I.
TO CONTRACTORS.

The Council of the Borough of Bangor invite TENDERS for the CONSTRUCTION of about 3700 YARDS of 7in., 9in., 12in., 15in., 18in., 21in., and 27in. STONEWARE and CONCRETE TUBE SEWERS; 1300 YARDS of 48in. by 32in. CONCRETE EGG-SHAPED TUBE SEWERS, together with MANHOLES, FLUSHING TANKS and VENTILATING SHAFTS; the CONSTRUCTION of about 1150 YARDS of 6in. and 18in. CAST IRON PUMPING MAINS, and about 30 YARDS of 30in CAST IRON OUTFALL SEWER; for the ERECTION of THREE SMALL PUMPING STATIONS, SUCTION and PUMP CHAMBERS; the ERECTION of a STORAGE TANK with SCREEN HOUSE, PUMP and SUCTION CHAMBERS and other appurtenant WORKS, all in accordance with plans and specification prepared by the Engineers, Messrs John Taylor and Sons, Caxton House, Westminster, London, S.W. 1.
Copies of the specification, bill of quantities and form of Tender may be obtained from the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.
Drawings may be seen at the offices of the Engineer or at the office of the Surveyor, Town Hall, Bangor, Co. Down, Ireland.
The works are for the relief of the unemployed, and the contract will be subject to special conditions laid down by the Ministry of Labour, Northern Ireland, for public utility schemes.
Sealed Tenders, endorsed "Bangor Main Drainage, Contract No. 1," addressed to the undersigned at his office at Bangor, must be received before Twelve Noon on Monday, the 6th day of October, 1930.
The Council does not bind itself to accept the lowest or any Tender.

By Order,
J. MILLIKEN,
Town Clerk.

Town Hall, Bangor, Co. Down, Ireland.
7th August, 1930. 5583

Caterham and Warlingham

URBAN DISTRICT COUNCIL.
MAIN DRAINAGE.

The Urban District Council of Caterham and Warlingham are prepared to receive TENDERS for the CONSTRUCTION, in the Parish of Warlingham, of about 24,100 YARDS of STONEWARE and CAST IRON SEWERS of 7in., 9in., and 12in. in diameter, together with all MANHOLES, VENTILATING SHAFTS and other appurtenant WORKS, in accordance with plans and specification prepared by the Engineers, Messrs. W. H. Radford and Son, Albion Chambers, King-street, Nottingham.
Contractors desirous of tendering may obtain copies of the general conditions of contract, specification, bill of quantities, and form of Tender from the offices of the Engineers upon payment, by cheque only, of the sum of £5 (Five Pounds), which will be returned upon receipt of a bona fide Tender.
The drawings may be inspected at the offices of the Engineers or at the Surveyor's Department, Council Offices, Harestone Valley-road, Caterham.
Sealed Tenders, endorsed "Tender for Warlingham Drainage," must be delivered to the undersigned at the Council Offices, Caterham, not later than Saturday, the 6th day of September, 1930.
The Council do not bind themselves to accept the lowest or any Tender.

By Order,
F. E. DIMMOCK,
Clerk of the Council.

Council Offices, Caterham, Surrey.
11th August, 1930. 5590

Commissioners of Northern

LIGHTHOUSES.
NORTH RONALDSHAY FOG SIGNAL.

The Commissioners invite TENDERS for the SUPPLY and ERECTION of a SIREN FOG SIGNAL INSTALLATION at North Ronaldshay Lighthouse, Orkney.
Drawings and specification may be seen at the office of Mr. D. A. Stevenson, M. Inst. C.E., Engineer to the Board, 84, George-street, Edinburgh, from whom copies of the schedule of measurement may be obtained on depositing £2 2s., which will be returned on receipt of a bona fide Tender. Offers, in sealed envelopes, marked on outside "Tender for North Ronaldshay Fog Signal," to be lodged with the undersigned not later than 10 a.m on Saturday, the 30th August.

J. GLENCORSE WAKELIN,
Secretary.

84, George-street, Edinburgh. 5620

Great Western Railway.

The Directors of this Company are prepared to receive TENDERS for the EXTENSION of the SOUTH PIER at Port Talbot Docks, South Wales.
Plans may be seen and forms of Tender, general conditions, specification, and bills of quantities obtained at the office of the Engineer at this Station, between the hours of 10 a.m. and 4 p.m., by payment of Two Guineas, which will be returned to bona fide tenderers.
Tenders, addressed to the undersigned and marked outside "Tender for South Pier Extension, Port Talbot," will be received not later than 10 a.m. on Tuesday, the 16th proximo.
The Directors do not bind themselves to accept the lowest or any Tender.

F. R. E. DAVIS, Secy.

Paddington Station, London,
18th August, 1930. 5644

Slough Urban District Council.

TO PUBLIC WORKS CONTRACTORS.
CONCRETE PUMP CHAMBER AND ENGINE-HOUSE FOUNDATIONS.

The Council invite TENDERS for the CONSTRUCTION of a CONCRETE PUMP CHAMBER (as an extension to the existing Pump Chamber at Datchet), METER PIT, BORE-HOLE CHAMBER, &c.
Copies of the plan, specification and bill of quantities can be obtained from, and conditions of contract seen, at the Council's Offices on payment of £2 2s. returnable deposit.
Sealed Tenders, endorsed "Concrete Pump House, Datchet," together with plan, specification, and bill of quantities, to be delivered to the undersigned not later than Twelve Noon on Wednesday, September 3rd, 1930.
The lowest or any Tender will not necessarily be accepted.

ALAN BROMLY, A.M.I.C.E.,
Water Engineer and Surveyor.

U.D. Council Offices, William-street, Slough.
August 15th, 1930. 5619

Trowbridge Water Company.

ASSISTANT ENGINEER FOREMAN REQUIRED.
Thorough knowledge Gas and Oil Engines, Deep-well Pumps, Main Laying, Plumbing, Electrical knowledge advantage.
Salary £200 per annum.
Applications, with copies only of testimonials, on or before Tuesday, August 26th, 1930, addressed
MANAGER,
5638 22, Silver-street, Trowbridge.

PUBLIC NOTICES

Administrative County of

LONDON.

The London County Council invites APPLICATIONS for a HEAD of the GAS ENGINEERING and SUPPLY DEPARTMENT at the Westminster Technical Institute, Vincent-square, S.W. 1.
Candidates should have had workshop experience and possess an Engineering Degree or Diploma.
Salary £580-£25-£725 a year. Further particulars of the appointment will be furnished to applicants.
Apply, Education Officer (T.1), County Hall, S.E. 1 (stamped addressed foolscap envelope necessary) for form, to be returned by 30th September.
Canvassing disqualifies.

MONTAGU H. COX,
5572 Clerk of the London County Council.

City of Bradford.

WATERWORKS ENGINEER.

APPLICATIONS are INVITED by the City Council for the APPOINTMENT of WATERWORKS ENGINEER.
Applicants must be members of the Institution of Civil Engineers and must state their age, their experience in designing, constructing, carrying out, and managing waterworks.
Particulars of the duties and conditions appertaining to the appointment will be sent by me on request.
Applications, accompanied by three recent testimonials, and endorsed "Waterworks Engineer," must be delivered to me not later than 10 a.m. on Wednesday, 10th September next.
The appointment will be subject to the Local Government and Other Officers' Superannuation Act, 1922, and to the successful candidate passing satisfactorily a medical examination.

N. L. FLEMING,
Town Clerk.

Town Hall, Bradford.
8th August, 1930. 5584

Two Temporary Technical

ASSISTANTS (ENGINEERING), 28 to 38 years of age, to prepare working drawings, specifications and estimates for plant in large hospitals and institutions, in particular of Steam Boilers, Engines, Deep-well Pumping Plant, Central Kitchen Apparatus, Laundries, Central Heating and Hot Water Supply Systems. Rate of pay £6 a week. And TWO TEMPORARY JUNIOR TECHNICAL ASSISTANTS (ENGINEERING), 21 to 26 years of age, capable of preparing working drawings for Steam Boiler Plant, Central Hot Water Supply Systems and Heating Installations. Experience in engineer's office necessary. Rate of pay £4 a week.
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SITUATIONS OPEN

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Address, 5626, The Engineer Office. 5626 A

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ENGINEER (33), A.C.G.I., B.Sc., Just Returned from installation complete factory overseas, special experience CHEMICAL and FOOD INDUSTRIES, DESIRES FRESH APPOINTMENT, Great Britain preferred.—Full particulars of experience from G. H. FARRINGTON, Penn Club, 8, Tavistock-square, London, W.C. 1. P187 B

ENGINEER, Age 42, 1st Class B.O.T. Certificate, 20 years' sea experience in steam, 4 years chief engr., ex-Engr.-Lt., R.N.R., SEEKS POSITION. Would consider small investment for suitable post.—Address, P182, The Engineer Office. P182 B

ENGINEER, Just Retired at Age Limit (55) from charge of large Government mechanical works in India, which he has reorganised, DESIRES RESPONSIBLE EMPLOYMENT; Experience besides administrative is special in mass production, and also in fully interchangeable out-turn. Would accept secondary position and medium salary in order to have something to do.—Address, P173, The Engineer Office. P173 B

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PARTNERSHIPS

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For continuation of Small Advertisements see page 4.

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Specialists in Design and Manufacture
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A Seven-Day Journal

A Floating Power Station.

A FLOATING power station is to be used on a section of the New England coast line, parts of which are now developing so rapidly that the power requirements cannot be accurately gauged. The idea is to install steam-driven generating plant on board ship and to tie up the vessel at a quay near to the desired spot, supplying the necessary fuel and water from the shore, and coupling up the generating plant to the land lines. The 380ft. standard ship, the "Jacona," originally owned by the United States Shipping Board, has been set apart for this purpose, and she is now being reconditioned by the Newport News Shipbuilding and Drydock Company. The power plant will comprise two 10,000-kW turbo-generators, to be built by the General Electric Company, and designed to work at a steam pressure of 400 lb. per square inch, with 250 deg. of superheat. Steam will be generated in four Babcock-Wilcox marine type, oil-fired, water-tube boilers, working at 428 lb. per square inch, and furnished with superheaters and air heaters. The boilers are to be placed in the forward part of the ship, and the arrangement will be such that, if desired, the plant can be converted to burn pulverised coal, should it be considered desirable to do so. The turbo-generators are to be in the mid and after parts of the ship, with the switchboard in the 'tween deck spaces. When her conversion is completed, the "Jacona" will be commissioned at one of the New England ports, and should her services be required elsewhere, it will be then quite easy to cast off and tow her to some other spot where the demand for current is more pressing. Many proposals have been made for using surplus tonnage. This one is certainly not without interest to engineers.

Improvements on the L.M.S. Railway.

AN extensive scheme, embracing both railway and dock improvements, which will involve an expenditure of over 2¼ million pounds, is being carried out by the London, Midland and Scottish Railway Company. Part of the work includes the widening of lines at several key points between Bromsgrove and Stoke, which will facilitate traffic between the West of England and the Midlands and the North. Other widening schemes include work at Mirfield in Yorkshire and also in Derbyshire between Broadholme and Ambergate, while in the London area the line between Barking and Upminster is to be widened and electrified, and new stations are to be built. At Camden, Birmingham, Great Bridge and Stoke-on-Trent improved facilities for goods traffic are to be provided, while dock modernisation and improvement schemes are to be carried out at the ports of Ayr, Troon, Grangemouth, Fleetwood, Goole, Garston, and Swansea. Between Camden and Watford a new system of semi-automatic signalling is to be installed, which will enable the London suburban service to be intensified. In conjunction with the L.N.E.R. Company the line between Manchester and Altrincham is being electrified, and a new line for mineral traffic—the Mid-Nottinghamshire Joint Railway—is being constructed in the county of Nottinghamshire.

Co-operation between Technical Institutions.

DEFINITE progress, it would appear, is now being made with the scheme designed to bring together various scientific and technical institutions studying subjects in which chemistry plays a principal part. In a public notice which has appeared this week, intimation is made of the fact that application has been made to the Board of Trade to register, as with limited liability, an "Association for the Promotion of Co-operation between Scientific and Technical Societies and Institutions within the British Empire." The objects of the Association are stated to include the co-ordination of the activities, discussions, and researches of societies dealing with mining, metallurgy, chemistry, fuel, petroleum, and rubber. In order to carry out the scheme of co-ordination, it is proposed to establish in London or elsewhere a central building for the use of the affiliated societies and to provide and equip within the building libraries, reading-rooms, lecture halls, museums, laboratories, council rooms, offices, and other conveniences for the societies, their staffs and their members.

A Shipping Centenary.

IN the present year the Isle of Man Steam Packet Company is celebrating its centenary, and in a souvenir booklet it has placed on record some interesting facts which illustrate the advance made in marine propulsion in the period since its establishment. The company's first ship was the "Mona's Isle," which was launched on the Clyde in 1830, only eighteen years after Henry Bell's "Comet." She was a 116ft. paddle steamer of 200 tons, with engines of 100 horse-power and was built by John Wood and engined by Robert Napier. A smaller and faster steamer, the "Queen of the Isle," was supplied by the same two firms in 1834. Other noteworthy ships were the two paddle steamers "Queen Victoria" and "Prince of Wales," which were built and engined by the Fairfield Company in 1887. They were 330ft. ships of 1557 gross tons. The engines had a nominal output of 925 horse-power, or 6500 indicated horse-power, and an average speed of 20½ knots was developed. In 1891 the third "Tynwald," a twin-screw ship, was built. She was followed in 1896 by the "Empress Queen," a 360ft. steamer of 2140 gross tons, with engines of 1290 nominal and 10,000 I.H.P., and with a speed of 21½ knots. This ship was the largest and fastest paddle steamer owned by the company, and she was followed later by several twin and triple-screw ships. The company's latest steamer, which was placed in commission this year, is the "Lady of Mann," which is a 22-knot twin-screw geared turbine driven ship 373ft. in length, with a measurement of about 3100 gross tons. She is equipped with the latest propelling and auxiliary machinery, with a designed output of 11,500 S.H.P., and was built and engined by Vickers-Armstrongs, Ltd., at Barrow-in-Furness. During the official trials a speed of 23 knots was attained.

A Rural Electrification Scheme for Norfolk.

AT the request of the Electricity Commissioners, the Norwich Corporation has agreed to develop a rural electrification scheme on the same lines as the Bedford scheme, in order to demonstrate the possibilities of rural electrification in more than one part of England. The scheme involves about 125 square miles in rural Norfolk, and electricity will be specially supplied from the Thorpe station of the Norwich Corporation, which is one of the two selected generating stations under the East England electricity scheme of the Central Electricity Board. The Commissioners desire that electricity should be made available for every house or farm in the new area, except isolated cottages, without any contribution being required towards the cost of the necessary mains by the consumer, and without any guarantee of a minimum consumption. It is expected that the scheme will be of real practical value to farmers, who will be able to study the effects of the application of electricity to agriculture when current is supplied at a reasonable price, and in accordance with the conditions laid down by the Commissioners. Apparently, the plans are not yet complete and the cost of the scheme is not definitely known, but the Board is said to be confident that the scheme will prove a success. A two-part tariff will serve to encourage extensions in the use of electricity once a supply has been made available, and a scheme of assisted wiring is also to be adopted, so that new consumers will not be forced to make a large cash payment at the outset.

A Floating Dock for New Zealand.

AN order has been placed with Swan, Hunter and Wigham Richardson, Ltd., for the construction of a large floating dock for Wellington Harbour, New Zealand. The order, which, we understand, has now been under consideration for many years, has been placed by the Wellington Harbour Board. The dock will be built to the designs of Messrs. Clark and Standfield, of Westminster, and will have a designed lifting capacity of 17,000 tons. Its overall length, including the platforms, will be 584ft., with a clear width of 88ft., while the width overall will be 117ft. 6in. The work of construction, which will occupy a large number of men, will probably take about a year. When completed, the towing of the structure to its final destination will present an interesting problem, as the distance to be covered is over 12,850 miles, which will constitute a towing record for a dock. One of the last docks built by Swan, Hunter and Wigham Richardson, Ltd., was that for Singapore, which was safely towed in two sections a distance of over 8500 miles. The firm has already constructed thirty floating docks for use in all parts of the world.

H.M. Airship R100.

AT 2.30 a.m. (B.S.T.) on Thursday, August 14th, the airship "R 100" left the St. Hubert mooring tower near Montreal on her return voyage across the Atlantic. Although one of her six engines was out of action, she was at first favoured by a following wind, and for a time her speed averaged 76 miles an hour. Early on the following day strong head winds were encountered, which reduced the vessel's speed to 15 miles an hour. Rain was also met with, and it is somewhat disquieting to learn that it penetrated the fabric and stopped the working of the electric cooker. At midday on the 15th the wind again became favourable, and with five engines running the ship reached a speed of 100 m.p.h. Shortly after midday on Saturday, August 16th, the vessel reached Cardington, 57 hours 5 min. after leaving St. Hubert airport. On her return flight she carried sixteen passengers, in addition to her officers and crew, and at the end of it had 3200 gallons of petrol remaining in her tanks. Except for the penetration of the fabric by rain, the flight was without accident, and almost without incident. At its conclusion, however, while the vessel was being refueled at the Cardington tower, one or two of her petrol tanks broke loose from their attachment and crashed through the fabric. On the day following her return the airship was taken to her shed. It is learned that work on the lengthening of her companion, the "R 101," is proceeding rapidly and satisfactorily. The framework was divided on July 29th, and a fortnight or so later the new bay was assembled and hoisted into position. The additional gas bag to be fitted in the new bay will give the vessel an increased capacity of about 500,000 cubic feet, and an extra 15 tons of lift. Other modifications which have been effected will add a further 6 tons to the lift. It is understood that success has attended the efforts to make one of the Beardmore heavy oil engines reversible, so that on her next flight all her five engines should be available for forward propulsion instead of, as hitherto, one engine being reserved exclusively for reverse running.

Sydney Harbour Bridge.

ON Tuesday of this week, August 19th, the delicate operation of closing the gap between the two half arches of the Sydney Harbour Bridge was successfully accomplished. The arch has a span of 1650ft. and rises to a height of 450ft. above the water surface of the harbour. It will support a deck about 135ft. wide, which will provide space for four lines of electric railway, a roadway 56ft. wide between kerbs, and two 10ft. footways. Below the deck there will be a clearance of 170ft. at high water for the passage of ships. The bridge is being erected by Dorman, Long and Co., Ltd., of Middlesbrough, who secured the contract with a tender of £4,217,721. With the approach spans and other expenditure, the cost of the whole work will be in the neighbourhood of £7,000,000. The contract provides that the work shall be finished by December 31st, 1931, and it is stated that the contractors have no doubt as to their ability to complete it by that date. The bridge is being erected in accordance with the general scheme prepared by Dr. Bradfield, engineer to the New South Wales Government, and to the detailed designs and calculations of Mr. Ralph Freeman, Messrs. Dorman, Long's consulting engineer. The greater part of the steel employed in the construction of the bridge is of a special quality and was rolled in this country and was shipped to Australia by the Australian Shipping Conference Lines without loss. Mr. Lawrence Ennis has since the beginning of the work acted as the contractors' resident director in Sydney, and has had entire charge of the erection of the structure.

The Late Mr. G. G. Sim.

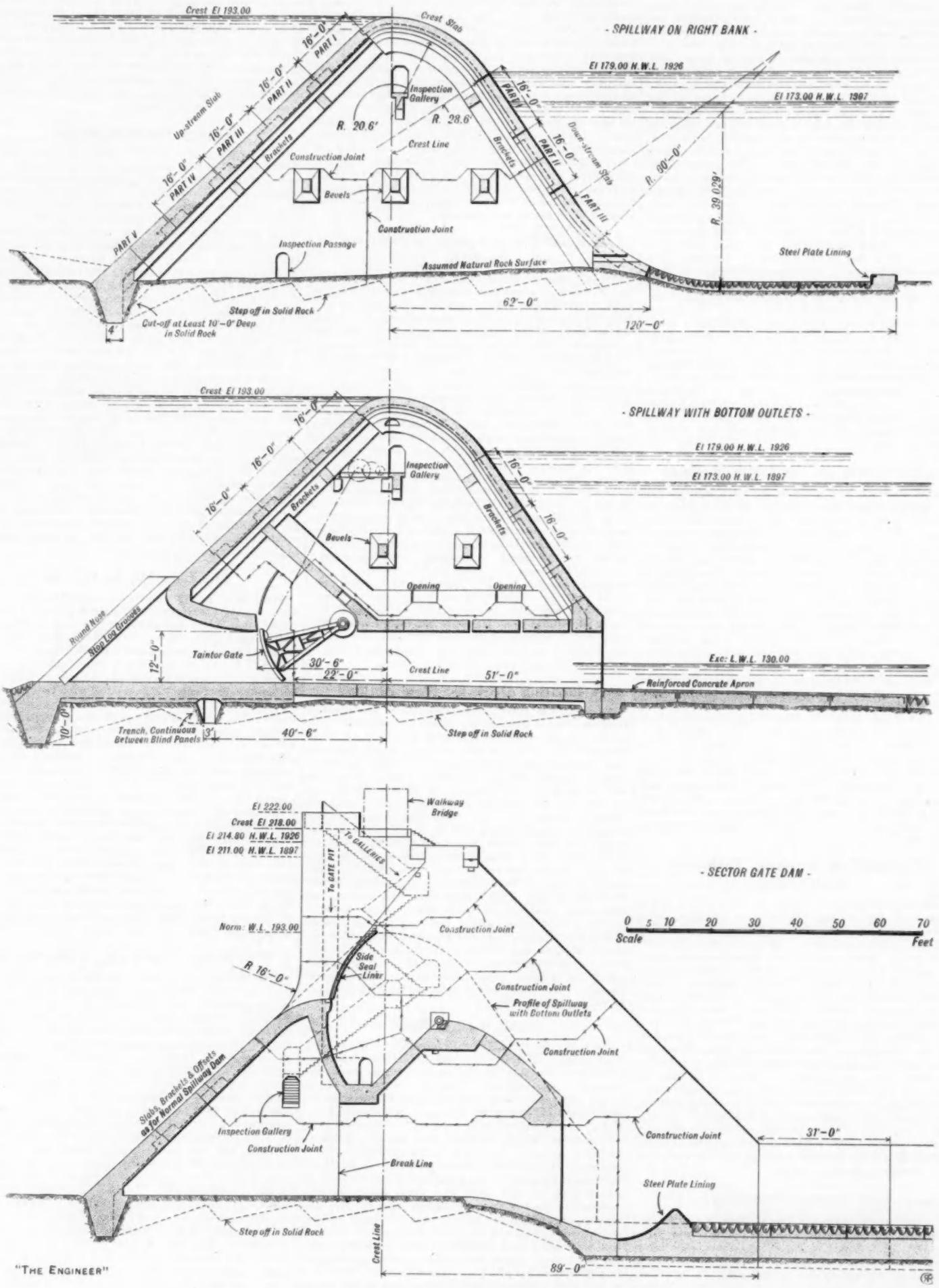
WE greatly regret to have to record that Mr. G. G. Sim, deputy chairman of Vickers Ltd. and Vickers-Armstrongs, Ltd., died at Elgin, Scotland, on Wednesday, August 20th, after a very short illness. Mr. Sim before becoming associated with Vickers Ltd. was attached to the Indian Civil Service. He was transferred to the Central Indian Government in 1920, and his name will always be associated with two measures of outstanding importance in the financial history of India. He was entrusted with the responsible and onerous task of consolidating and improving the Indian income tax law and with its subsequent administration, and afterwards rendered no less valuable service as Financial Commissioner to the Railway Department. In the latter capacity he played a prominent part in the separation of railway from general finance, a reform which was justly characterised as the greatest financial achievement in India of recent years. Mr. Sim joined Vickers Ltd. on July 1st, 1926, and was appointed secretary on July 15th of that year. Subsequently he became a director of Vickers Ltd. and Vickers-Armstrongs, Ltd., and of several of the associated companies. On March 11th, 1929, he was appointed deputy chairman of Vickers-Armstrongs, Ltd., and on November 6th, 1929, deputy chairman of Vickers Limited.

The Salford Electricity Undertaking.

THE Salford City Electrical Engineer's report for the year ending March 31st, 1930, shows that in spite of the general trade depression the undertaking has made appreciable progress. Although development has been chiefly on the domestic side, the demand for electric power showed a greater increase than in the previous year. During the year 1338 consumers, representing 8673 kilowatts, were connected to the mains, making a total of 15,353 consumers with 91,979 kilowatts, an increase of 9·5 per cent. in consumers and 10·4 per cent. in kilowatts. Two hundred and twenty-six motors, with an aggregate capacity of 1173 horse-power, were connected to the mains, bringing the total number up to 4500 with an aggregate capacity of 50,178 horse-power and representing an increase of 5·3 per cent. in motors and 2·4 per cent. in horse-power. At the end of the financial year the Agecroft power station contained one 20,000-kilowatt set, and three 12,000-kilowatt sets. The quantity of fuel consumed was 55,200 tons, as compared with 53,175 tons for the previous year, whilst the average price per ton was 14s. 10d., compared with 14s. 3d. The quantity of fuel used per unit sold was the same as in the previous year, namely, 1·89 lb. During the period covered by the report 236 consumers were changed over from direct current to alternating current, the total number of consumers that have been changed over being 2273. The cost of the alterations to consumers' existing apparatus has been borne by the electricity department.

THE PERAK RIVER HYDRO-ELECTRIC POWER SCHEME

(For description see opposite page.)



"THE ENGINEER"

SECTIONS OF THE CHENDEROH DAM

The Perak River Hydro-electric Power Scheme.

No. I.

AMONG the Federated Malay States, Perak* is one of the foremost in the production of tin, and it was with a view to supplying its numerous tin mines with power that the Perak River Hydro-electric Power Company was formed in 1926.

The State of Perak is watered solely by the Perak River and its tributaries, chief among which is the Kinta River, which joins the Perak some 30 miles

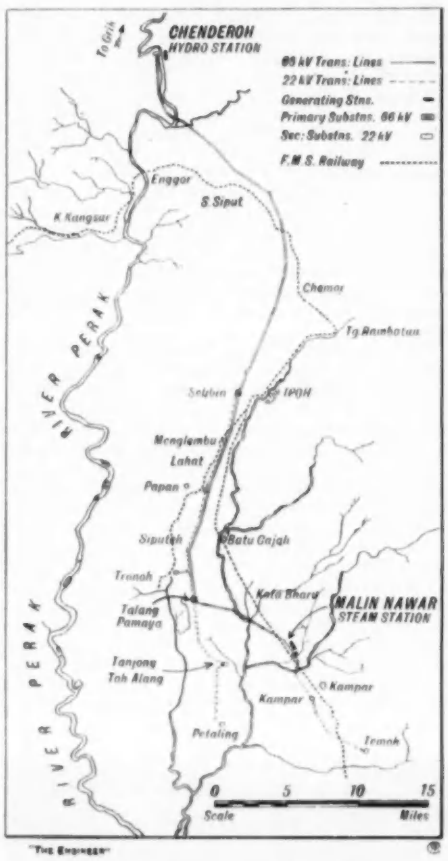


FIG. 1—THE PERAK AND KINTA RIVERS

from its mouth—see Fig. 1. It is in the valley of the Kinta River that the principal deposits of tin are found, but as this river is too small for power development on a large scale, the Perak River, which has a considerable discharge, has been utilised, and the power transmitted to the Kinta Valley. The valleys of the two rivers run parallel for some considerable distance, separated by a range of mountains rising to 4000ft. A site suitable for power generation was found at Chenderoh, some 18 miles north of Kuala Kangsar, where the flow data of the river, based on ten years' observations, are as follows :—

Discharge during 12 months	2200 cusecs
Discharge during 11½ months	3000 cusecs
Discharge during 11 months	3400 cusecs
Discharge during 10 months	4000 cusecs
Discharge during 9 months	4400 cusecs
Discharge during 6 months	6100 cusecs

The catchment area above this point is 2350 square miles. The river is subject to heavy floods during the rainy season, and provision has accordingly been made in the discharge capacity of the dam at Chenderoh for floods up to 470,000 cusecs, under which conditions the crest of the dam would be submerged by 29ft. The greatest flood so far experienced occurred in December, 1926, and was estimated to have reached 320,000 cusecs.

CHENDEROH HYDRO-ELECTRIC POWER STATION.

The Chenderoh power station is situated at a point where the Perak River flows between two high banks, and where a solid granite foundation is available—see the Supplement. There a dam has been constructed to produce a head of 60ft. under normal conditions. Under flood conditions, however, the water level below the dam rises more rapidly than in the reservoir above, with the result that the effective head may fall as low as 33ft.

The reservoir formed above the dam has an area of approximately 10 square miles, which is sufficient to meet the daily variations of load during the dry season, although not enough to maintain the normal output of the station. The site of the reservoir was mainly virgin jungle, and a large amount of felling and burning had to be carried out before the reservoir was filled. Because of the indented nature of the shores of the storage basin, its periphery is about 200 miles long.

The main Government road between Kuala Kangsar and Grik was at some points lower than the proposed level of the water in the reservoir. It was therefore necessary to divert the road and raise its level for a total distance of approximately 2½ miles, in order that it should be immune from the danger of flooding after impounding the water in the reservoir.

Preliminary works at the dam site, including rock drilling in the river bed and construction of the camp, approach road, and temporary suspension bridge over the Perak River—see Fig. 3—were begun towards the end of 1926, together with the necessary anti-malarial measures. These latter were undertaken in consultation with Sir Malcolm Watson, M.D., LL.D., member of the Malaria Advisory Board, Federated Malay States, and proved extremely satisfactory. The incidence of fever, including all cases, was reduced to 0·43 per cent., and averaged 1·96 per cent. during the period of construction. These figures are remarkably low, considering that the labour force numbered between 4000 and 5000.

The dam—see Fig. 2—is constructed for the greater part as a hollow reinforced concrete structure of the Ambursen type, and is slightly curved in the upstream direction in order to obtain the best rock foundations and a sufficient length of spillway. At the break points and on the left bank, however, it is constructed as a solid gravity dam. The spillway portion, with a crest at El. 193ft., has a total length of 684ft., and is divided into two sections by a sector gate, which has a free opening of 100ft. and is situated between piers near the centre of the river. Typical cross sections are shown in the engravings on page 190.

The hollow spillway section of the dam consists of reinforced concrete slabs, forming a continuous deck, both on the upstream and downstream faces. These slabs are supported on reinforced concrete buttresses, spaced 18ft. apart on centres and braced with horizontal concrete struts in every second bay. The slabs are held in place by offsets and notches in the buttress heads. Vertical contraction joints are provided at each buttress, and horizontal joints are arranged at intervals of 16ft. between each section of the slabs.

The bottom of the dam in the deepest part of the river channel is provided with nine sluices, through which the entire river was passed during the construction of the central portion. Each sluice has an opening 14ft. wide and 12ft. high, and is lined with steel plating anchored to the concrete. The sluices are closed by steel Taintor gates, operated from a platform inside the top of the dam. The bottom sluices are arranged in three groups of three, with a blind panel between each group permanently closed on the upstream side. These blind panels act as contraction joints between the groups of bottom sluices, and also serve as drainage outlets to prevent excessive uplift on the dam.

The upper portion of this sluice section is similar to that of the spillway dam, except that a horizontal concrete diaphragm with transverse slots in its downstream end is provided above the sluices. This arrangement serves to reduce any difference in the water levels in adjacent bays. Further protection against differential pressure between the buttresses is effected by communicating openings through the buttresses themselves.

The Taintor gates consist of a skin plate bent to a radius of 20ft., and fastened to angle frames attached to trunnions which are secured to the concrete of the buttresses. These gates are capable of withstanding a head of 86ft., and, when raised, are accommodated in a space inside the dam above the steel linings. The outlets are made water-tight at the sides and at the top and bottom sills by rubber seals, carried by the gate and pressed tightly against the fixed parts by the pressure of the water. The operating gear is mounted on a platform at El. 175ft. inside the dam. It consists of a line shaft extending over all the gates and driven from either end through reduction gearing by an electric motor. This shaft drives, through a friction clutch, the gate-hoisting gear, consisting of two pinions, each meshing with the teeth of a rack rod attached to one side of the gate.

The sector gate dam is provided at the top with a pit, into which the gate is lowered when open. Since the water is allowed to enter this pit when the gate is open, the slabs forming the pit have been made as water-tight as the upstream face of the dam. The solid piers at each end of the sector gate dam have their tops at El. 218ft., and one of them carries the gate-operating gear.

The gate, 103ft. long and 16ft. high, consists of a skin plate supported by twelve sector-shaped frames, each of which is hinged to a bearing built into the dam. The upper surface of the gate is provided with timber decking in which slots are cut near the upstream edge. These slots admit water to the gate pit when the gate is lowered, and the upward thrust of this water balances the weight of water flowing over the deck. The weight of the gate complete is approximately 140 tons, but, being hydraulically balanced, it requires very little force to move it. The operating gear consists of rods with racks and pinions; it is driven through reduction gearing from a 17 H.P. motor mounted on one of the piers above flood water level and connected to the gearing on the other pier by a steel shaft. A view of the sector gate dam, with a temporary closure, taken during construction, is reproduced in Fig. 6, page 202.

The solid gravity-type dam on the left bank has the same spillway curve as the hollow spillway dam and is of similar height. This part of the dam, the piers, and the abutments at the ends were poured in sections with vertical contraction joints extending down to the foundations at intervals of 30ft. The abutments on either bank are non-overflow gravity dams with a crest at El. 218ft. and extend into the river banks at the ends. Fig. 7 shows the dam nearing completion. In the Supplement, views are given of the work at various stages.

The bed of the river below the dam is protected from scour by reinforced concrete aprons extending some 100ft. downstream and provided with a steel-lined retarding wall to break up the jet of water spilling over the dam. In order to make the heel of the dam water-tight the upstream slab was extended into the solid rock and grouted under pressure. An inspection and drainage tunnel runs the full length of the dam close behind the cut-off trench, and a gallery communicates with the Taintor gate operating gear at El. 175ft. from either end of the dam. In addition, a steel footbridge spans the right-hand spillway section and the sector gate, and affords access to the operating gear for that gate.

The intake is an extension of the dam near the right bank. The lower portion, as shown in Fig. 3, is of similar construction to the spillway dam. Above, it is divided into sections by three pairs of heavily reinforced buttresses, the intake for each power unit being between one pair. Each opening is 21ft. wide and 20ft. 6in. high and is provided with trash racks and closed by a single head gate. The

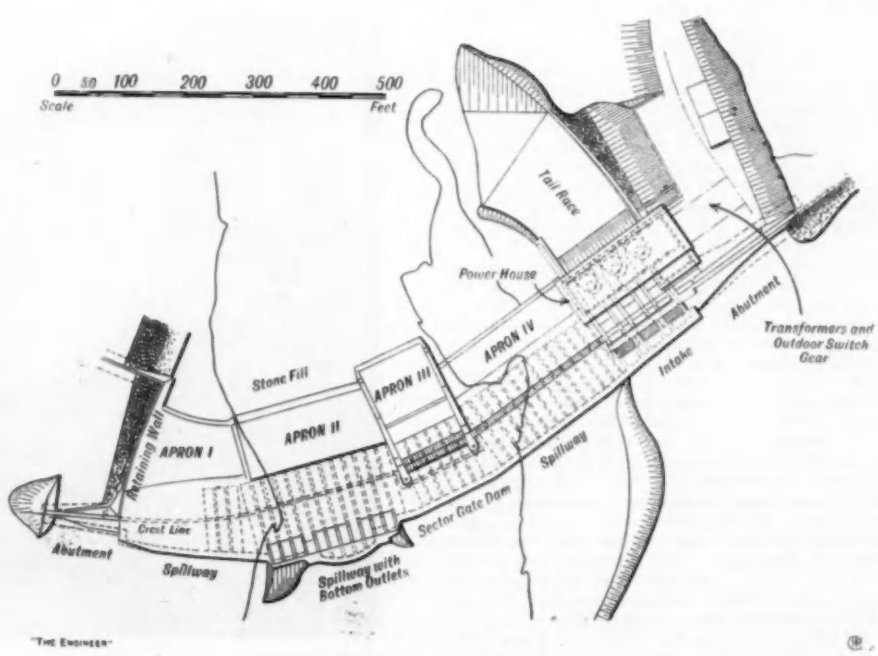


FIG. 2—PLAN OF DAM AT CHENDEROH

* The native pronounciation of this name is *Peeru*, with the accent on the first syllable and the final *k* silent.

gate is built of steel plate supported on a framework which is mounted on a carriage having four rollers on each side. It is capable of being operated under a head of 44ft. when there is no water on the downstream side. The rollers run on vertical steel rails secured to the concrete of the buttresses to which the water thrust is transmitted. The operating gear is mounted directly over the gate on a superstructure, the gate being raised or lowered by a rack attached to each side.

The river traffic at Chenderoh consists of timber rafts and sampans, and in order to transport these craft from one side of the dam to the other a boatway has been constructed. This boatway consists of a broad-gauge—5ft. 6in.—railway track on the right bank between the reservoir and the river below the dam. A bogie wagon 15ft. wide and 43ft. long and capable of carrying the largest raft navigating the river is hauled along this track by a petrol-driven locomotive of 125 H.P. provided with a winch for drawing the raft out of the water.

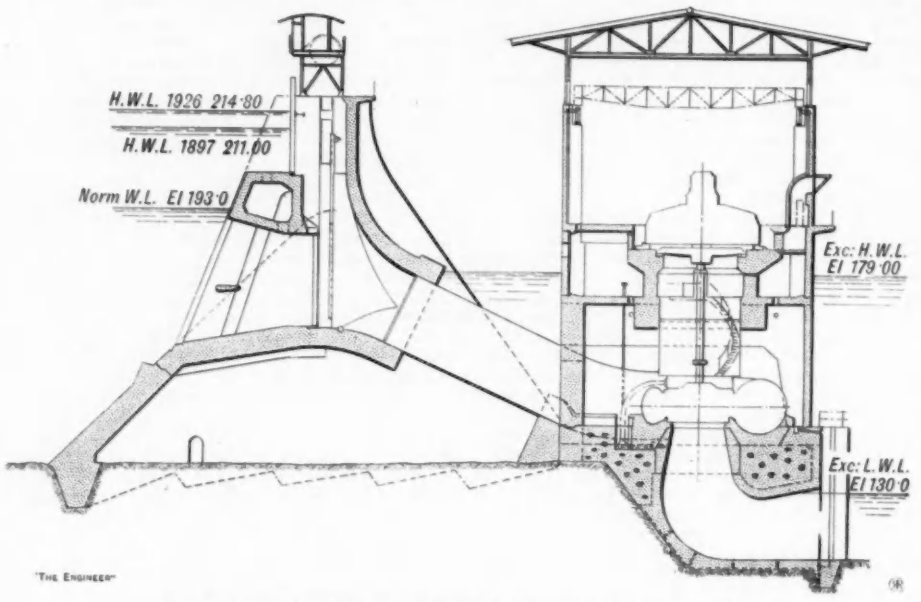


FIG. 3—CROSS-SECTION THROUGH INTAKE AND POWER-HOUSE

The power-house—Fig. 3—situated close behind the intake, is a reinforced concrete building having three main floors. The lower floor supports the turbines, the draught tubes of which form part of the substructure. During floods when the tail water level is high, the turbine floor is flooded, and in order to protect the turbine covers a steel casing 18ft. in diameter is erected over the turbines, reaching up to the floor above and accessible from it. This floor, 31ft. above the turbines, is used for cables, pipes, and various auxiliaries, while the generator floor at El. 190ft. forms the main floor of the station. Strong reinforced concrete columns support the girders for the travelling cranes in the generator room, windows being provided in the walls between the columns. The generator floor is extended on the landward side to provide an unloading space.

A switch house in the form of an annexe is situated on the upstream side of the power-house at the landward end. This house contains the battery room, 6600-volt switch cubicles, and a staff room in the basement, while on the generator floor level are the control room, superintendent's office and entrance.

The turbine spiral casings are connected to the intake by short self-supporting steel penstocks. The power-house contains three turbines, each coupled to a 9000 kW. generator. The turbines are of the vertical-shaft Francis type, with steel spiral cases and a single runner. They are each required to give 9025 kW on the shaft when utilising 2000 cusecs at a head of 60ft., and 9150 kW with the gates fully opened at a head of 53ft. Their speed is 93·8 r.p.m. The runners weigh 20 tons each and are constructed of cast steel with mild steel cast-in blades. Because their size—the maximum diameter is 12ft. 4in.—exceeded the maximum loading gauge of the Federated Malay States Railways, special transport arrangements had to be made from the port of entry to Kuala Kangsar. The runners were finally taken to the site from Kuala Kangsar or Taiping by road.

The servo-motors for operating the guide vane mechanism are mounted on the turbine covers, but the governors and actuators are on the generator floor, being belt driven from the generator shafts and connected to the servo-motors by pressure oil pipes. Each unit is supplied by its own oil pump, but the reservoirs are interconnected so that in the event of a breakdown of one pump one governor can be supplied with pressure oil from the others.

The generators are connected directly to the turbines by 20in. diameter hollow-bored steel shafts. Because of their low speed the generators are very large, being some 26ft. across the stator. They are rated at 11,250 kVA at 0·8 power factor and generate at 6600 volts, three-phase, 50 cycles per second. The stators are sunk below the floor level and ducts are formed round them into which the hot air from the machines is discharged and led out of the building. Cool air is drawn in at the centre of the machines from the generator room by fans on the rotors. The rotor rings, because of their large size, could not be transported to the site in their entirety. Consequently the hubs and spiders were made with a split across a diameter. The rims are composed of laminations dovetailed to the ends of the spider arms and were built up on the site. The poles are pressed into other dovetails on the outer edges of the rotor rims and are keyed in position.

The thrust bearings are of the Michell type and are carried on the upper brackets. They support the whole weight of the rotating parts and the unbalanced water thrusts on the runners, amounting to some 170 tons per machine. The whole of each bearing is immersed in an oil bath which is cooled by water circulating through cooling coils. There are three guide bearings, two on each generator and one on each turbine, which are normally supplied by a self-contained pump. For emergency use a motor-driven standby pump is provided, which can supply any machine. Direct-coupled exciters are mounted on each shaft above the thrust bearing. They have each an output of 105 kW at 60/250 volts.

Two 50-ton overhead travelling cranes are provided for service in the power station. They can be coupled and used together with a balancing beam for lifting into place the alternator rotor, which weighs about 80 tons. For lighter lifts they are equipped with an auxiliary hoist of 10 tons capacity, and also with a 3-ton pulley block.

The current from the generators is led by paper-insulated lead-covered cables to sheet steel cubicles in the switch house basement, which contain isolating switches and the connections for the service supply to each machine. The service equipment consists of a three-phase transformer, 100 kVA, 6600/420 volts, which supplies on its low-tension side the auxiliaries for the main unit, and also the general station service switchboard. This switchboard can be supplied by all three machines, but the connecting oil switch is interlocked with the main extra high-tension transformer switch in such a way that the low-tension switch cannot be closed until the main switch is closed. The station service board is situated in the control room on the floor above, where also are the desk panel controlling the main switches in the outdoor sub-station and the engine-room telegraphs to the main generators.

Each generator is directly connected to one bank of transformers without the interposition of any oil switches, the generator and transformer bank being operated as one unit. Each transformer bank is composed of three single-phase oil-immersed water-cooled units of 3650 kVA, delta connected on the low-tension side and star connected on the high-tension, there being one spare unit. The high-tension pressure of the bank is 66,000 volts, but tapping switches are provided to give +5 per cent. The cooling of the oil is effected by circulation through an oil cooler supplied with water from the reservoir. The water discharge from the cooler is passed through an ejector connected to the turbine cover drainage system, the arrangement acting as an automatic standby in the event of the failure of the drainage pump.

The transformers are of the outdoor type, and are placed in the outdoor switch station, together with the 66-kV circuit breakers and isolating switches. The sub-station is built of steel girders on concrete foundations supporting the duplicate 66-kV bus-bars and isolating switches, and also serving as a dead end for the outgoing lines. The transformers and oil switches are mounted on concrete plinths below this structure. The oil switches, of which there are six, namely, three transformer, two line and one bus coupler, are arranged with each phase in a separate tank. The operating gear is of the solenoid type, and is controlled from the bench board in the control room. The isolating switches are gang-operated from the ground level by a rod and lever arrangement, capable of being locked in position. A metre-gauge track permits both transformers and oil switches to be taken into the power-house for overhaul or repair. The neutrals of the three transformer banks are earthed through an arc suppressor of the Petersen coil type of 1300 kVA. If the fault is of such a nature that the arc persists, a relay, connected to the secondary of the coil, operates to close an oil switch. This switch, on closing, inserts a limiting resistance in parallel with the coil, which allows sufficient current to flow to operate the protective gear and trip the line switches. The Petersen coil and the earthing resistance are both oil-immersed and are situated in the outdoor sub-station.

FIG. 4—INTERIOR OF POWER HOUSE

(To be continued.)

THE General Council of Sofia has assigned a sum of 750,000 leva for the organisation of telephonic communication between forty-two villages in its district. The communes interested will supply the necessary telegraph posts, while the technical work will be in the charge of the Ministry of Posts, Telegraphs and Telephones. The 750,000 leva are for the purchase of apparatus and wire. The length of the new lines will be 230 kiloms.

Modern Die-Casting Practice.

By ERNEST V. PANNELL.

No. II. (*Conclusion*).*

Dies.

The steel moulds or dies used in the die-casting industry are the most advanced examples of the tool-maker's art. Seldom, or never, does a die consist simply of two rectangular blocks of steel containing a cavity; more usually it is a complicated working mechanism involving possibly half-a-dozen removable cores, dowels, ejector plate and pins, sprue-cutter, vents and water passages. In a metallurgical sense die development has been a study of steel composition capable of resisting the effect of molten metal many times per hour at the melting temperature of tin, lead, zinc and aluminium. For the first two metals, a low carbon steel is satisfactory; for zinc a higher carbon preferably heat-treated, but for aluminium alloys a special alloy steel is necessary to meet the severe conditions without showing surface cracks after a few thousand castings have been produced. Dies used for white metal last almost indefinitely. Those for zinc may show slight surface cracks after 25,000 castings, although the dies may be used for, perhaps, four times that number. Aluminium appears to be very uncertain in its effect upon alloy steel dies, but they may, under good conditions, not exhibit heat cracking until 20,000 castings are produced, and may thereafter last as long again. Steels more recently evolved have been found to yield a total of 50,000 to 70,000 castings, and developments in the direction of improved die steels and treatment are taking place rapidly with the approach of commercial die-casting in brass.

The great pressure behind the metal, its fluidity and the definite attack of iron by aluminium, combine to make die service extremely severe, and economical production is best realised by use of the most suitable alloy steel, and the most careful heat treatment. Chrome-vanadium, nickel and tungsten-chrome steels have been employed, of which the last-mentioned is, perhaps, the most popular at present, but further developments are now under way which may lead to an entirely different steel coming into use in the near future. Treating of present practice, the die steel may contain from 4 to 8 per cent. tungsten and 3 per cent. chromium. The actual manufacture of the die is, of course, dependent partly on its composition. In carbon steel, the cavities can be hot pressed by using a hardened steel press tool of the shape of the finished casting. Undercuts can subsequently be built up and the die finished by hand. Alloy steel, on the other hand, cannot be hobbed or pressed in this way, and the dies must, therefore, be milled. Great accuracy is required in this intricate work, and not infrequently a profiling machine is used in which a tracer passing over the contour of a master pattern causes the milling cutter to follow exactly the same contours on the work. Shrinkage allowed for on the dies takes into account the fact that their working temperature is about 350 deg. Cent. as compared with that of the molten metal, 700 deg. Cent. for aluminium. In the case of zinc, the die temperature will be about 220 deg. and the metal 440 deg. Feeding an extended section is usually accomplished by casting-in small shrink pads at uniform intervals. These pads or strips may be $^1/_{64}$in. to $^1/_{32}$in. in thickness and $\frac{1}{4}$in. to $^3/_{16}$in. wide, and are usually disposed on the inside of the casting on a surface which need not be smooth.

After forging and before cutting, the die blanks are normalised and annealed. When the tool-makers' work is finished the dies are heat-treated For the tungsten chrome steel above mentioned, this consists in heating to 1010 deg. Cent., air cooling and tempering at 565 deg. Cent. These operations are performed in electric resistance furnaces having thermostatic control, the dies being packed in steel containers to protect them from oxidation. A useful practice now widely used is to plate the die surfaces with chromium. This appears to inhibit oxidation and to give a greater life to the die and a better finish to the final castings. In some quarters the die, instead of being plated, is sprayed with a wash of iodine and peroxide. This, however, is more applicable to the carbon steels used with zinc alloys. The foregoing procedure for heat-treatment is varied by some die makers who substitute warm oil for air quenching. Hardness on the Brinell machine should be from 400 to 440 after tempering.

The mechanical design of the die comprises the two sections which correspond to the drag and the cope in foundry practice except that in most cases the parting line is vertical. In general, these two portions are unequal in size, the cope, or that containing the gate, being the smaller. The greater part of the casting and the cores are disposed in the drag, which is the part retracted by the die-opening mechanism, A third important part of the mould is the ejector plate, containing the pins or dowels, which project into the die proper. The ejector plate comes into action when the die is parted and the pins bear on the casting forcing it out of the cavity. It can then be removed by the operator's tongs. With a centre gate machine, however, it is clear that the sprue must also be cut or broken before the casting is free. This is usually accomplished by a sprue-cutter, which is forced into the gate immediately before the dies are opened. The sprue-cutter is usually a tapered steel plug made of the same material as the cores. Turning to the cores proper, these furnish the most intricate problems in die design, and in most instances the first consideration in setting out a new die is to decide how the cores can best be drawn. Castings are becoming more difficult day by day, and occasionally a job is encountered which is quite impracticable in its original form simply because of the impossibility of coring it up. In such a case two die-castings may be necessitated instead of one. A simple casting would be in the nature of a bush or sleeve having only one core. A number of such castings could be gated and all cores drawn simultaneously in the same die.

Considering next a T fitting, it will be seen that the cores must be pulled at right angles to one another, not always an easy matter to accomplish. Adding another branch to the T leads to the drawing of cores in three dimensions at right angles to one another, and the difficulties are very greatly enhanced. Most cored castings, although they appear complicated, fall in the class of a simple bush as above described, and a much smaller percentage require cores to be aligned in several directions. In the most modern machines, however, it is often possible to pull cores on all sides of the die. The actuation or movement of cores is provided by a rack and pinion. Teeth are cut on the projecting part of the core which engage with a pinion, the latter actuated from the drive of the machine. Some time ago it was the custom to advertise and sell die-castings having "cast in" internal threads. This naturally necessitated the cores being screwed out and led to slow production and other difficulties. Most castings are now produced with plain holes, which are afterwards tapped in the usual way.

Amongst other factors entering into die design is the use of inserts. These are sometimes required in the finished castings and may be in the form of brass or bronze bushings, steel pins, sheet iron punchings for magneto field systems and the like. All such inserts must be clean and hot to prevent blows. They are placed in the die while it is open, and for this purpose suitable prints must be provided. A portion of the insert will, of course, project from the finished casting and must be afterwards removed. The actual grip of the casting on the insert is generally improved by knurling, threading or punching the latter. Inserts consisting of tubes or coils are not uncommon and are cast in without difficulty. It must be remembered of all tempered steel inserts that though they will retain their temper in a zinc casting, they will be annealed if used in aluminium.

Venting, as already indicated, is partly provided for by the use of shims or distance pieces on the parting line to maintain a clearance of about 0·007in. Grooves can be cut in the parting surfaces to increase the venting capacity, and spaces can also be provided around ejector pins. Some die makers use a square pin working in a round hole as a vent. The matter of dimensional accuracy of the final castings is closely associated with the material and workmanship of the dies themselves. Commercial tolerances allowed are 0·001in. for tin and lead alloys, 0·002in. for zinc and 0·004in. for aluminium, these being per linear inch of casting. Wall thickness as cast may be as small as $^1/_{16}$in. for white metal and zinc, and about $\frac{1}{4}$in. for aluminium. A section of short length can be run of somewhat less thickness.

Metals and Alloys.

Development of die-casting metals, as already seen, has successively involved alloys of tin, lead, zinc, aluminium, and, more recently, brass. For industrial and engineering purposes, zinc and aluminium alloys are at present paramount. Tin need be referred to only in connection with the extensive production of bearings having the white metal die-cast direct into the bronze shells. Early experiences with zinc alloys showed a lack of stability and permanence which was a serious handicap to their development. This was undoubtedly explained by the absence of foundry history or adequate metallurgical background to the use of zinc. Since the facts have been better appreciated and higher qualities of metal become available, the alloys have been developed to a new plane of quality and use. As ordinarily produced, the principal impurity in zinc is lead, which may be from $1\frac{1}{2}$ to 2 per cent. Early experiences have shown that, in die-casting alloys, this is not permissible. Swelling, distortion, and cracking appear to be largely dependent upon the content of lead, tin, and cadmium, and these are perforce kept down to a combined maximum of 0·10 per cent. The effect of these elements is most serious in those zinc alloys which contain aluminium in from 3 to 5 per cent. Not only must the zinc and aluminium be of the highest purity, but contamination arising from machine plunger mechanism, gooseneck, or metal pot must be strictly avoided. Experienced die-casters recommend that, not merely separate machines, but separate departments, or even buildings, should be employed for production of zinc-base and lead-base die-castings respectively. Following the realisation of these facts, several new alloys have been developed, having markedly superior properties to those used before. Not only is there an improvement in tensile strength and elastic limit, but a relative absence of the swelling and distortion effect under exposure to steam or other accelerated tests. A useful summary of these alloys is comprised in the series adopted for test in a current research programme of the American Society for Testing Materials, as under:—

(A)	Per cent.	(B)	Per cent.	(C)	Per cent.
Zinc	94·75	Zinc	93·0	Zinc	92·9
Copper	5·00	Copper	3·0	Copper	3·0
Aluminium	0·25	Aluminium	4·0	Aluminium	4·0
				Magnesium	0·1
(D)		**(E)**		**(F)**	
Zinc	92·9	Zinc	93·7	Zinc	90·5
Copper	3·0	Copper	3·0	Copper	3·0
Aluminium	4·0	Aluminium	3·0	Aluminium	0·5
Magnesium	0·1	Magnesium	0·3	Tin	6·0
(G)		**(H)**		**(I)**	
Zinc	93·9	Zinc	93·0	Zinc	92·9
Copper	2·0	Copper	3·0	Copper	3·0
Aluminium	4·0	Aluminium	4·0	Aluminium	4·0
Magnesium	0·1	Magnesium	Nil	Magnesium	0·1

The main purpose of the study was not the comparison of different alloys—it will be seen that the composition shows very little variety—but the observation of the behaviour of different grades of virgin zinc on the ultimate properties of the die casting. In the above list high-grade zinc is employed in alloys A, B, C, and E. This metal according to specification shows impurities totalling a maximum of 0·10 per cent., comprising lead, iron, and cadmium. Alloys D and G are of a special high grade, having maximum impurities of 0·06 per cent.; while I is a still more highly refined product, having 0·02 per cent. impurities. F is included for purposes of comparison, and employs commercial or "Prime Western" zinc which may contain as much as 1·60 per cent. lead and 0·08 per cent. iron. Lastly, H is a special grade, but has impurity limits of 0·25 per cent. Physical tests have been made on the above group of alloys using specimens both flat and circular, produced as nearly as possible under commercial die-casting conditions, and the average tensile strength obtained varied from 28,000 lb. to over 49,000 lb. per square inch. It is noteworthy that all four alloys with the magnesium constituent and high-grade zinc showed from 47,000 lb. to 49,000 lb. tensile strength, with perceptible elongation, a Rockwell (E) hardness of 95 to 99, and notably superior impact resistance as compared with the other compositions. The research programme alluded to is still in progress, and the results of a series of exposure tests, both steam and atmospheric, will later be published. Sufficient has been shown to establish the remarkably high quality and permanence of the newer zinc alloy die-castings, which are now closely in line with the light alloys for engineering purposes, and which have the useful advantage of economy in respect of cost of material and investment in dies.

Alloys of aluminium naturally retain the important merits of light weight, considerable ductility, and resistance to many corrosive influences which affect other metals. In motor and aircraft parts and in machine sections where the mechanical load is largely due to the weight of the part itself, aluminium will continue to have the advantage. A far greater diversity of properties and analysis is available than with the heavier alloys, and developments have not been neglected which would bring out still higher qualities. Alloy practice in America is well represented by the series of compositions adopted for experiment by the American Society in the research programme already referred to, namely:—

(J)	Per cent.	(K)	Per cent.	(L)	Per cent.
Aluminium	94	Aluminium	88	Aluminium	84
Copper	4	Copper	10	Copper	14
Iron	2	Iron	2	Iron	2
(M)		**(N)**		**(O)**	
Aluminium	93	Aluminium	85	Aluminium	93
Copper	Nil	Copper	Nil	Copper	2
Silicon	5	Silicon	13	Silicon	3
Iron	2	Iron	2	Iron	2
(P)		**(Q)**		**(R)**	
Aluminium	89	Aluminium	93·5	Aluminium	88·5
Copper	4	Copper	1·5	Copper	4
Silicon	5	Silicon	0·75	Silicon	1·5
Nickel	Nil	Nickel	2·25	Nickel	4
Iron	2	Iron	2	Iron	2
(S)		**(T)**		**(U)**	
Aluminium	91	Aluminium	88	Aluminium	89
Copper	Nil	Copper	2	Copper	8
Silicon	2	Silicon	8	Silicon	1
Nickel	5	Nickel	Nil	Nickel	Nil
Iron	2	Iron	2	Iron	2

By reason of the solvent effect of aluminium on the metal of the pot and gooseneck, an appreciable percentage of iron is always present in the finished casting, and the 2 per cent. included in the above compositions represents what may be expected under fair working conditions. Larger amounts may be met with, particularly under improper supervision, and in excess will render the molten metal sluggish and the resulting castings brittle. As may be expected, the good qualities of silicon alloys are very difficult to achieve unless the iron impurity is a minimum. Development of light die-casting alloys has been in progress for fifteen years. At the outset, the standard foundry mixtures of aluminium and copper and aluminium and zinc were used. The latter was promptly dropped because of its hot-shortness, which led to many cracked castings. From 8 to 12 per cent. copper was usual. At a later date, nickel was introduced as a further constituent. The resulting aluminium-copper-nickel alloys have useful properties, such as filling the die remarkably well and possessing considerable strength at high tempera-

* No. I. appeared August 15th.

tures, and the subsequent castings are ductile and yield a high and lasting polish. The introduction of silicon in 1921 was of considerable value to the industry, and the 13 per cent. alloy at once came into use. A modified or refined structure of the metal resulted from the rapid chilling which is inseparable from the process without the use of any refining compound. The ductility achieved was also far in advance of that possible with any previous die-casting alloy. Some manufacturers have stated that a lower percentage of silicon was more favourable to the life of the gooseneck and dies.

With increasing size of die-castings many have to be machined; in fact, practically all are drilled, tapped or otherwise manipulated, in which event the "drag" associated with silicon alloys is embarrassing, and part of the silicon is, with advantage, replaced by copper or nickel. In the latter case the addition of nickel appears to improve the life of the die. Other reasons for the diversity of analyses above are not strictly metallurgical, as it is found that a certain alloy is preferred by one manufacturer in preference to others simply as a matter of custom and shop practice. Much of this diversity could be narrowed down by standardisation. Physical tests of the alloys above tabulated indicate an average tensile strength ranging from approximately 28,000 lb. to 34,000 lb. per square inch, with an elongation on 2in. of 1 to 6 per cent. As in the case of the zinc-base alloys, the most significant comparative figures are expected to result from the exposure tests. Primary values of tensile strength, ductility and impact resistance are found to be at least as dependent upon the technique of the manufacturer as upon the composition of the alloy, though the latter will have more influence on the corrosion resistance.

The Protection of Alternating Current Generators.

No. III. (*Conclusion*).*

For the protection of generators, overload, or more correctly speaking, overcurrent, relays are sometimes employed. When several generators are operating in parallel overcurrent relays afford a measure of protection, but considering that the setting of such relays must be high enough to prevent the possibility of operation on normal generator loads or overloads, the protection is extremely limited. The overcurrent relay cannot, therefore, replace a circulating current protective system, nor can it in any way be regarded as a discriminating relay for generator faults. When used on generators, however, it fulfils the important function of protecting the machine and system against bus-bar faults, which in the ordinary way demand the disconnection of all generating plant. Bus-bar faults may be considered in their reaction on continuity of supply of even greater importance than generator failures, and while it is obviously not feasible to include them within the sphere of the generator circulating current protective system, the alternative of leaving them unprotected is most unsatisfactory.

An overcurrent relay having suitable characteristics will provide all the protection necessary, but it must

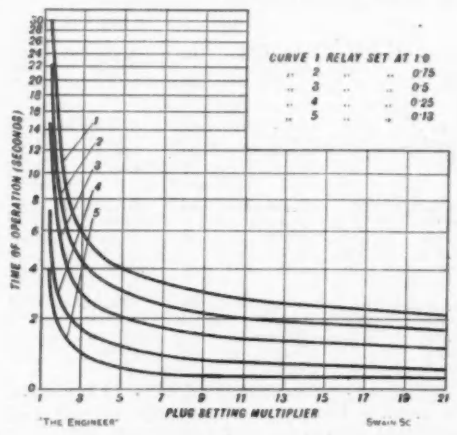


Fig. 11—Type P.B. Relay Curves

give reliable discrimination with the feeder relays so as not to cut off a machine when the fault is on the network beyond the bus-bars. Operation must be assured for the condition when the generator short-circuit current has fallen to its reduced steady value, and it must not be possible for normal generator loads or overloads within the rated capacity to operate the relay to cut off the machine. The second and third requirements are difficult to reconcile, since it may happen that the steady current value is the same for the two conditions, under one of which the relay must not operate while definite operation is desired in the other case, but, by the use of relays having a combined inverse and definite minimum time lag characteristic, differentiation between these two conditions is possible. Such a relay is the Metropolitan-Vickers P.B. type, which in operation has a time lag that decreases with increasing current up to about five times the setting current to a minimum value which remains practically constant for all values of current in excess of that figure—see Fig. 11.

The initial value attained by the short-circuit current of a generator varies with the circuit reactance and is, of course, a minimum with minimum reactance. The circuit reactance for a bus-bar short circuit usually approaches the minimum, and the high initial current results in the relay operating on the definite minimum time lag portion of its characteristic. The operation will therefore be approaching completion when the short-circuit current has fallen to its steady value, which for modern turbo-alternators has an average value of one and a-half times to twice the normal full-load current—see Fig. 12. The total time to clear

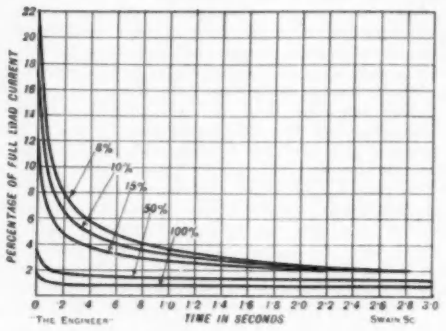


Fig. 12—Turbo-Alternator Short Circuit Curves

the fault is therefore kept short, since only a small fraction of the operating period occurs on the inverse portion of the time curve. The short time lag under this condition is in marked contrast with the time lag obtained when the operation is due to generator overload caused, say, by load demand. In this case, although the current may be little, if any, less than the steady value reached in the preceding case, there is no initial peak, and consequently the entire operation occurs on the long inverse portion of the characteristic, giving a maximum time of about thirty seconds, which will be generally long enough to put the machine out of danger of being cut off before the abnormal demand subsides.

Immunity from operation on feeder faults is attributable to the inverse definite minimum time characteristic. The capacity of individual feeders is usually small in comparison with that of the generator, and in consequence the fault current for a feeder fault represents a greater percentage of the normal feeder capacity than it does of the generator capacity. The feeder relays will therefore operate at a lower point on the time characteristic, and the time lag is always shorter than that of the generator relay, which, by virtue of the smaller current supplied by its current transformer, operates at a point higher up the inverse portion of the curve, and even if the time setting is the same for both relays this holds good.

Relays having a time delay function that is entirely independent of the value of the operating current are sometimes used on generators to protect the bus-bars, but are generally inferior to the type described. Known as definite or constant time limit relays, the time characteristic is a straight line parallel with the operating current axis, and time discrimination can only be obtained by strict grading of the time settings of successive relays, the time of operation under any and all fault conditions being a definite function of the number of relays in series. The maximum setting is limited to three seconds or less, since heavy faults cannot be allowed to disturb the system for longer periods on account of the danger of synchronous plant falling out of step. This means that generator overloads will also be restricted to a three seconds limit, which allows no time for any measures designed to relieve the overloaded machine before it is tripped off by the relay. Moreover, no advantage is gained from the difference in ratio between the current transformers operating the generator relay and those for the feeder relays, discrimination between them being, in consequence, more precarious. Similarly with bus-bar short circuits, no advantage in speed of operation is gained by the initial high value of the current peak, and, in consequence, the time taken to clear such a fault is always longer than the corresponding time for an inverse time limit relay, despite the higher time lag obtained with the latter for small overloads and minor faults. A characteristic time curve for a definite time limit relay superimposed

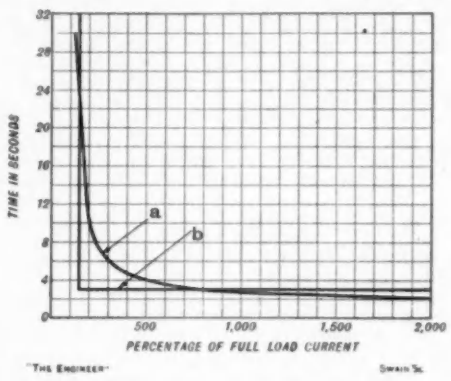


Fig. 14—Relay Time Current Curves

on that of a type "P B" inverse and definite minimum time limit relay is shown in Fig. 14, a study of which will establish the superiority of the latter relay for use on generators. *a* is the time curve for the "P B" type inverse and definite minimum time limit relay set for 30 seconds maximum and 2·2 seconds definite minimum, and *b* the time current curve for a definite time relay set for 3 seconds. It is not possible to employ definite time limit relays on machines if inverse time relays are used on the feeders.

Following on simple overload protection, one of the earliest forms of generator protection was the reverse power relay. When used on generators running in parallel with others, it affords a certain measure of protection against insulation failures, the reverse feature enabling long time lags to be dispensed with, and in this respect at least can be claimed to be an advance on the ordinary over-current relay. But

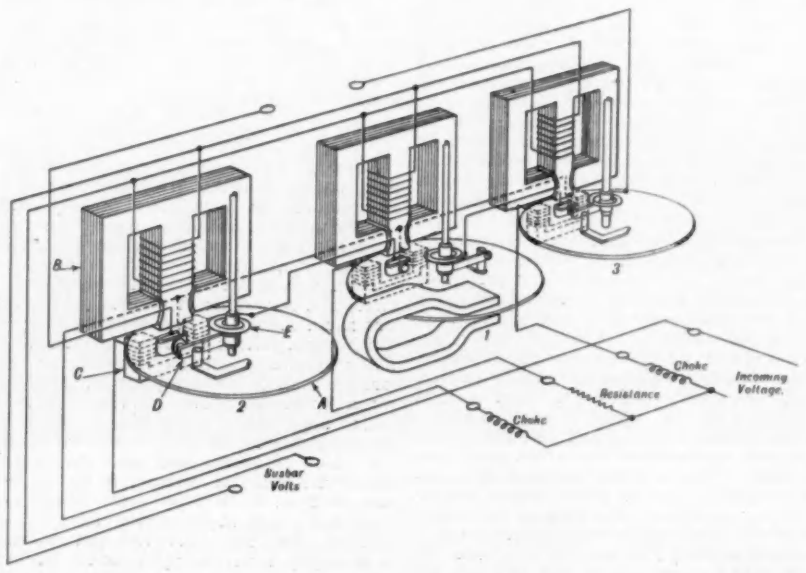


Fig. 13—Synchronising Relay

experience has shown that reversal of power does not only take place during generator faults. Disturbances on the system are often the cause of reversal of power in healthy generators, owing to synchronous plant "pumping back," and it is not uncommon for power to circulate momentarily between two or more generators if there is any tendency for the machines to drop out of synchronism on heavy system faults before the governors can fully respond, and unless the reverse power relay is given a high setting or, alternatively, has a delayed operation, it is quite possible for a healthy generator to be tripped under such conditions. But in any system for the protection of a generator, which it is vitally necessary

* No. II. appeared August 15th.

to protect to the greatest possible extent from damage and disturbance due to faults, two essentials are quickness in operation combined with comparatively low settings, and a reverse power relay possessing these essential features is as liable to trip a healthy generator as it is a faulty machine, and is therefore unsuitable for generator protection.

As shown in the early part of these articles, to be effective, the setting of a reverse power relay must not be more than 5 per cent. of the full load of the machine, which is much too low to give stability on system disturbances and a satisfactory alternative has been described. As regards the employment of reverse power relays to provide protection against faulty synchronising, it will be agreed that for that purpose the relay need only be operative during the actual synchronising operation, and can be disconnected at all other times. It thus follows that reverse or directional features are superfluous, and an ordinary instantaneous over-current relay can be substituted with advantage. The "F" type relay, which is quick-acting and robust, meets the requirements, and a setting equivalent to 25 per cent. of the normal full load of the generator is recommended, but several alternative settings can be provided if desired.

The operation of rendering the relay ineffective for further operation after synchronising should be automatic, and there are many ways of bringing that about, but probably the most convenient is to include an extra contact on the oil switch operating push-button or control switch, and connected in series with the tripping contacts of the relay, so that when the switch is released on the satisfactory completion of the synchronising operation, the relay contact circuit is automatically broken.

An alternative and even better safeguard against faulty synchronising is to employ the synchronising relay referred to at the beginning of these articles. This relay effectively prevents faulty synchronising, and, hence, entirely eliminates the possibility of undesirable effects, either on the machine or on the system. By connecting the contacts of the synchronising relay in series with the operating switch in the coil circuit of the auxiliary contactor, which energises the machine oil switch closing solenoid, the oil switch is prevented from closing until the voltages of the machine and bus-bars are in the correct relationship to each other. A perspective view of the synchronising relay is shown in Fig. 13, from which it will be seen that it consists of three separate elements, 1, 2, and 3, enclosed in the same case. Each element comprises a movable disc A under the control of electro-magnets B and C, and a spiral spring E. Each disc carries a contact arm D which engages with a fixed contact when the disc is rotated in a clockwise direction through a given angular distance, and as the three contacts are connected in series they must all be closed together to complete the relay circuit. The operation of the relay is as follows:—In the case of all three elements the electro-magnet B is energised from the bus-bar voltage, and the electro-magnet C from the incoming machine. In order to obtain the correct phase relations between the fluxes in B and C to give operation under the desired conditions, a non-inductive resistance is connected in series with the magnet C in the case of element 1, and a reactance in the cases of elements 2 and 3. The spring of element 1 tends to rotate the disc in an anti-clockwise direction, *i.e.*, away from contact.

When the phase difference between the two voltages is within approximately 45 deg. on either side of 0 deg., the torque due to the electro-magnets tends to rotate the disc in a clockwise direction, *i.e.*, to close contact, and during the remainder of the cycle the magnets and spring act together to rotate the disc away from contact. The springs of elements 2 and 3 tend to rotate the discs in a clockwise direction to make contact. During the half cycle, when the angular displacement between the voltages is between 0 deg. and 180 deg., the disc of element 2 rotates to make contact, and during the remaining half cycle to break contact. The disc of element 3 rotates to make contact when the angular displacement is between 180 deg. and 360 deg., and to break during the other half cycle. Actually, there is a slight overlap on either side of the ranges 0 deg. to 180 deg., as shown by the shaded areas in Fig. 15, and this allows for operation within narrow limits above or below the correct synchronising position.* The contacts of elements 2 and 3 are therefore closed together only during two periods in a complete cycle when the angular displacements are 0 deg. and 180 deg. respectively, *i.e.*, when the torque due to the electro-magnets is a minimum, thus allowing the springs E to rotate the discs to close contact. A cycle here refers to a complete revolution of one vector relative to the other, and will, of course, vary in duration according to the difference in frequencies of the two voltages. When the phase difference is 0 deg., *i.e.*, when the two voltages are in phase, the torque on the disc of element 1, due to the electro-magnets, will be a maximum in the clockwise direction, rotating the discs to close the contacts, while the torque on the discs of elements 2 and 3 will be a minimum, thus allowing the springs to rotate the discs to close the contacts.

Under this condition, all three elements will close their contacts, provided that the rate of variation of the angular displacement between the voltages as represented by the difference of their frequencies is small enough to allow time for the disc of element 1, which is magnetically damped, to be rotated sufficiently to close the contacts before the torque again reaches its minimum value. The relay circuit is thus completed when all the required conditions for synchronising have been reached. The rate of rotation of element 1 is adjusted so that differences in the speed of the two machines, greater than approximately 0·25 per cent. of normal, are sufficient to prevent the closing of the synchronising switch, and with a 50-cycle, two-pole machine with a normal speed of 3000 revolutions per minute, paralleling can only occur when the divergence from normal speed is within 7·5 revolutions per minute.

The theoretical aspect of the question of field suppression has been discussed in a paper read by Mr. Keyser before the Institution of Electrical Engineers.* The principal alternatives for this purpose include (1) an automatic switch in the alternator

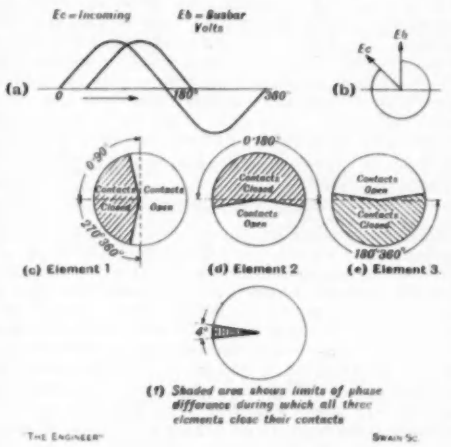


FIG. 15—DIAGRAM ILLUSTRATING OPERATION OF SYNCHRONISING RELAY

field circuit; (2) an automatic switch in the exciter field circuit; (3) an automatic reversing switch in the exciter field circuit, and (4) a rotor slip-ring short-circuiting switch. The practice of opening a switch in the main field circuit without the use of a discharge resistance gives the most rapid discharge of the field, and is the most desirable method from the point of view of protection. From other points of view the method presents no disadvantages. It is the usual practice with Metropolitan-Vickers standard machines and it is perfectly satisfactory. Before adopting it for other makes of machines having rotors composed of laminations or built-up plates, it is advisable as a precaution to ascertain that the inductive voltage rise when the field circuit is broken is within the value of the rotor insulation breakdown test voltage, that being done by connecting a needle spark gap set for a given safe value across the slip-rings, and if no discharge occurs at the gap, discharge resistances can safely be dispensed with. The breaker used is of the air-break pattern without blow-out devices, as it is not desirable to rupture the arc quickly when the breaker is opened, the reason for this being that the arc acts as a self-regulating resistance in series with the field windings and prevents the inductive rise in the rotor voltage from becoming unduly high.

An automatic switch in the exciter field circuit may be used with small machines up to 500 kilowatts, since the discharge time is fairly short even when a discharge resistance is included. The time is actually about twice as long as that obtained with a main field switch using a discharge resistance equal to that of the rotor. It is, however, a method that should not be used with compound-wound exciters, even if the alternator is small, since the series winding exerts an additional retarding influence on the field discharge, which is, in consequence, so slow that severe damage to the stator core and windings may result from a fault. Another disadvantage of interrupting the exciter field circuit is that the exciter residual voltage prevents total interruption of the main field current.

With an automatic reversing switch in the exciter field circuit, the exciter field is first broken and then immediately reversed. As with the previous method the discharge time is about twice as long as that obtained by opening the field circuit, and, as a consequence, it is not recommended for machines larger than about 500 kilowatts. An advantage of this method over the simple exciter field switch is that the exciter residual field is destroyed, thereby reducing the remanent voltage at the alternating current terminals. With the slip-ring short-circuiting switch method, the discharge time and the alternating current voltage conditions are the same as for the last method. As the exciter armature is also short-circuited, it is necessary to insert a loading resistance in the armature circuit to prevent sparking at the commutator. The arrangement consists of a single-pole, double-throw switch in the main field circuit, and in the normal position of the switch the exciter is connected directly to the slip-rings, whilst the loading resistance is short-circuited. Whilst in the operating position the slip-rings are short-circuited and the resistance is connected in series with the armature. Owing, however, to the sluggishness of the field discharge by this method, it is not suitable for large machines, and even for small machines it offers no advantages over the exciter field switch and requires, moreover, a larger and more costly switch.

The diversity of opinion held as to the correct relative times of opening of the generator oil switch and field switch respectively on the occasion of a fault, appears to have given rise to a number of different methods of tripping the field switch. The methods most frequently met with are (*a*) direct from the differential protection relays; (*b*) by means of an auxiliary switch on the alternating current oil circuit breaker; (*c*) by a combination of methods (*a*) and (*b*), and (*d*) by means of a time lag relay energised by the tripping of the alternating current oil circuit breaker.

As regards methods (*b*) and (*c*), the underlying motive in each case is, no doubt, a desire to ensure that the field switch does not open before the machine is cleared on the alternating current side, but it is a well-established fact that nothing of a serious nature results if the field circuit of one of several parallel running alternators is interrupted. Thus there is no necessity to take steps with a view to giving a definite sequence in the order of opening the alternating current and field switches, the main, and, in fact, the only object to be aimed at being to discharge the field as rapidly as possible when a fault develops. Method (*d*) was intended to prevent high voltages being induced in the rotor by the inductive effect of heavy fault currents in the stator, and to that end it attempts to delay the rupturing of the field circuit for a definite time interval after the alternating current side has been cleared; but experiments carried out on solid rotors have shown that the voltages induced in the rotor during stator faults involves no risk to the rotor insulation. The first method, which simply involves operating the field switch direct from the fault relays, is the most rapid in action and is the most satisfactory, and it requires no auxiliary equipment to supplement the ordinary contacts of the differential relay.

As regards the source of supply for tripping purposes there is, generally speaking, an independent direct current supply available from the station battery, and it is only in cases in which such a supply does not exist that difficulty arises. A satisfactory solution to the problem, however, is to use a primary battery of the sac Leclanché type composed of a sufficient number of cells to give a minimum pressure of 20 volts. These cells are inexpensive and may be relied upon for long periods, although periodic readings of the battery voltage under discharge conditions are essential and should be entered in the station log book. The usual arrangements for ascertaining the condition of the battery consist of an ammeter and resistance mounted on the battery containing case, and connected across the battery with a push-button switch in series. The resistance is adjusted initially to limit the current as measured by the ammeter to a value equal to that required by the trip coils, and the reading is thus an indication of the state of the voltage under operating conditions. The practice of utilising for tripping purposes a voltage supply derived from the protected circuit is undesirable, as such a supply is most likely to vary at the very time it is required, namely, at the time of trouble on the protected apparatus, and a serious variation from normal voltage may result in failure of the tripping mechanism to operate when connected to the supply by the fault relays.

* In the diagrams (*a*) and (*b*)—Fig. 15—the arrows indicate the relative movement of the two voltage vectors, that for the bus-bar voltage being regarded as fixed.

* *Journal*, I.E.E., July, 1922.

Report on London Waters.

No. I.

WE have been favoured with a copy of Sir Alexander C. Houston's "Twenty-fourth Annual Report on the Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended 31st December, 1929." The Reports of the Director of Water Examination to the Metropolitan Water Board are always eminently worth reading, and the present document forms no exception to the general rule. We propose, in what follows, to give our readers some idea of the contents of the volume.

The Report is, as usual, divided into Sections, and we deal with the Sections in the order in which they appear.

CHLORINATION OF THAMES RIVER WATER.

Some 76 million gallons of Thames River water had been chlorinated each day—with intermissions due to floods—since May, 1916. During all that time no complaints as to taste had been received, though—taking the average daily consumption per head at 38 gallons—some two million people had been consuming the water.

During the year under review, however, circumstances arose which necessitated a considerable modification in procedure. The Report states that, in the

month of July, owing to unsatisfactory bacteriological results in samples from the West Middlesex filters, it was decided to bring into operation plants, which had been installed at Barnes and Hammersmith, for the treatment of West Middlesex filtered water. Sulphate of ammonia was added to the general well at Barnes and chlorine to a subsequent general well at Hammersmith.

The treatment was started on July 20th and almost immediately tastes appeared in the treated waters. The cause was promptly traced to the fact that certain filtered water wells at Barnes had recently been heavily coated with some tarry paint. The water of condensation—impregnated with taste-imparting substances—dropping into the water, and also the vapour from the paint being absorbed, fully accounted for the taste. The trouble, it is explained, was rapidly overcome by removing some of the superfluous paint and by increasing, temporarily, the dose of sulphate of ammonia from 0·2 N to 0·4 N parts per million. The treatment of the unfiltered West Middlesex water at Hampton was continued for some time, but was subsequently discontinued, as it was found to be unnecessary. "The point, however, was established," remarks Sir Alexander, "that double chlorination is possible without provoking taste troubles."

On October 7th an instrument which had been installed at Hampton for the treatment of Southwark and Vauxhall filtered water, was brought into operation. By it, sulphate of ammonia, first, and subsequently chlorine, were added to the water. This treatment was successfully continued till the date of the Report.

The opening of the new works at Kempton Park* necessitated the remodelling of the chlorination plant in that area. The effluent from the secondary filters is now treated, first with sulphate of ammonia and then with chlorine, and provision is also made for similarly treating the filtered water from the East London—Sunbury—beds. The point of application of the chlorine to the Staines aqueduct was moved down to a position below the Kempton Park Works, and only the water going on to Hampton is now treated before filtration.

Appended to this section of the Report is a table showing the average number of million gallons filtered per acre of filter beds cleaned both before and after chlorination was instituted, the year ended March 31st, 1915, being chosen to compare with the year ended December 31st, 1929. It appears that at Sunbury (E. London) the gain was 5·83 million gallons, at Kempton Park 4·24, at Hampton 9·58, at Kew 5·29, and at the West Middlesex Works no less than 10·54 million gallons.

Chlorination of New River Water.

The chlorination of New River water is only carried out during the winter months, and the period covered by the Report was from October 29th, 1928, to March 28th, 1929. One hundred and two samples collected at Highfield, *before* chlorination, contained *B. coli* in 1 c.c.—or less—in 62·7 per cent. of the samples examined. The same number of samples collected at Wood Green, *after* chlorination, contained *no B. coli* in 100 c.c.—one hundred times as much water—in 90·1 per cent. of the samples examined. At the outlet from the Hornsey Reservoir the results were not quite so good, but they still showed a considerable improvement on the raw water figures, *i.e.*, 70·6 per cent. negative. Again, however, as in past years, the results obtained with the water coming from the Stoke Newington Reservoirs are described as being "not nearly so good"—only 6·9 per cent. negative. "This," says the Report, "is no new feature, but the puzzle remains. Do birds, fish or other forms of life account for the discrepancy? Is it conceivable, as some have hinted, that chlorination dopes, but does not kill, *B. coli*, and that apparently dead *B. coli* may recover their vitality? Laboratory results do not lend any support to this hypothesis." It is pointed out, however, that, in any case, the results are only disappointing in relation to the wonderful results at Wood Green and at the outlet from the Hornsey Reservoir. "The main point is that the effects of winter floods as shown above Highfield, before chlorination, are practically effaced in a bacteriological sense, by the chlorination at that station, so that when the water reaches Wood Green it is literally transformed in quality."

The Report contains some interesting figures regarding the cost of this treatment at Highfield. The treatment was carried on for 150 days. During that time 5222·5 million gallons were treated, 0·238 parts per million of chlorine, and 0·934 (=0·197 N) parts per million of ammonium sulphate being used. In actual weights, 5·55 tons of chlorine and 21·79 tons of ammonium sulphate were required, the cost being £109·91 for the former and £326·85 for the latter, or a total of £436·76. The costs of the chlorine and ammonium sulphate were 5·1d. and 1·3s., or a total of 1s. 8·1d. per million gallons treated.

Pre-filtration Waters.

Sir Alexander Houston began the study of the effect of storage on raw water a good many years ago now, and his investigations in this direction have been carried on continuously ever since, the results achieved being recorded in successive Reports. He was, we believe, the first to discover the very considerable purification of the water resulting from storage for some time in reservoirs. In this year's Report he shows, by means of a table, the enormous improvement in the bacteriological quality of the raw Thames, Lee and New River waters consequent on storage. "One method of showing how much better the stored waters are," he remarks, "is to take some of the positive *B. coli* percentages in the raw water and contrast them with the relative volumes of stored water yielding somewhat similar percentages. For example, the raw Thames River water contained *B. coli* in 57·7 per cent. of the samples in 0·1 c.c.—or less. Now, as the Chelsea stored water contained *B. coli* in 100 c.c. in 57·6 per cent. of the samples, it may be said that, on this basis, the Chelsea stored water was improved 1000 times." In fact, as the table shows, nearly all the pre-filtration waters were improved from 100 to 1000 times as the result of storage.

The results of the chemical examination of the stored waters are set out in another table. Regarding them, Sir Alexander says:—"It is obvious that the raw waters are, generally speaking, altered considerably in character by reason of storage, and that the percentage reductions for the various tests are not uniform, the tendency being for the ammoniacal nitrogen, turbidity and colour tests (especially the first two) to show proportionately greater reductions than the albuminoid nitrogen and permanganate tests. Of course, reductions are not invariable, but in these cases some explanation is usually forthcoming, for example, the undue development of 'plankton' growths."

The Barn Elms Experiments.

Rather more than seven years ago experiments were started at the Board's Barn Elms Station to ascertain the effect of rapid primary filtration prior to ordinary slow filtration. Later, special observations were made with one of the secondary filters worked at a much higher rate than is usual with slow sand filters. The object of these experiments was to see if, under these conditions of working, the filtrate from the secondary bed gave reasonably good results, on analysis, and also whether the filter was able, between successive cleanings, to pass more water than usual.

As a result of some sixty-four months' experience since the experiments were started, it would seem, says the Report, that the following results can be obtained, assuming comparable conditions, by the methods employed at Barn Elms:—

(1) A final effluent practically as good, on the average, as that resulting from the ordinary slow sand filtration process.

(2) Comparative freedom from algal troubles, or those caused by an excess of suspended matters, owing to the useful work carried out by the primary filters.

(3) A considerably greater output per acre of filtration area, allowing for the space covered by the primary filters, per unit of time.

Our readers are aware that the results of these investigations were considered to be so satisfactory that they led to the adoption of double filtration on a service scale, with excellent results, at several of the Board's stations. It has been found that from three to four times the volume of water can be treated in a given area in a given time as by slow filtration alone. It appears likely that the Board will adopt the double filtration system still more widely in the future, with, consequently, considerable economies.

The Walton Works.

The Walton Station was the first at which the Board adopted double filtration on a service scale, the whole of the water passed through the station undergoing primary and secondary filtration. The station itself was described in our issues of June 16th and 23rd, 1911, while the additional works were described in our issues of July 30th and August 6th and 13th, 1926.

The Report contains some figures, supplied by the Board's Engineering Department, showing the results obtained with the filters at this station during 1929. As these figures are of considerable interest we reproduce them below:—

Walton Filters, 1929.

Rate of Filtration.

(*a*) Primary Filters.			
1. Average	122·5	galls. per sq. ft. per hour	
2. Maximum	177·4	,, ,,	,,
3. Minimum	93·9	,, ,,	,,
(*b*) Secondary Filters.			
1. Average	6·02	galls. per sq. ft. per hour	
2. Maximum	6·9	,, ,,	,,
3. Minimum	5·24	,, ,,	,,

Primary Filters.
Number of hours worked between successive cleanings.

1. Average	47·3	hours
2. Maximum*	263·2	,,
3. Minimum	3·0	,,

Secondary Filters.
Number of million gallons filtered per acre cleansed.

1. Average	333·4	m.g.
2. Maximum	684·0	,,
3. Minimum	108·0	,,

Percentage of Wash Water Used.

(*a*) Primary Filters.		
1. Average	0·53	per cent.
2. Best period	0·077	,,
3. Worst period	1·64	,,
(*b*) Secondary Filters.		
1. Average	0·048	per cent.
2. Best period	0·018	,,
3. Worst period	0·158	,,

* The beds are not generally run for longer periods than ten days without being washed.

Concerning these figures the Report draws special attention to the following points: (*a*) the high rate of filtration through the secondary filters (6·02 gallons per square foot per hour), having regard to the much lower rates commonly employed; and (*b*) the remarkably high number of million gallons filtered per acre cleaned (333·4).

As regards the quality of the water sent out from this station, 93·6 per cent. of the 249 samples taken from the general filter well, which were examined, gave negative *B. coli* results in 100 c.c. "Bacteriologically," remarks the Report, "it would be difficult to improve on these results." It is to be noted that the water is chlorinated after filtration.

Surbiton (Lambeth) Taste Troubles.

After sections devoted to "Resistance to Filtration and Microscopical Appearances of Pre-filtration Waters," "Search for Pathogenic Microbes in Water," and "Iodine in Water," the Report passes on to discuss a case of taste trouble. It appears that on Sunday, August 11th, 1929, many of the consumers of water from the Surbiton (Lambeth) Works complained that the water had an objectionable taste and smell. The matter was at once investigated and the complaints were found to be justified. "It was discovered," the Report states, "that the water from the 54in. main supplying the filter beds was the immediate cause of the trouble. The water comes from the Island Barn Reservoir, which was known at the time to contain *oscillaria* (tufted variety) in great abundance. This growth, however, is common in the Board's reservoirs, and has never previously given rise to any taste, and indeed the water in Island Barn Reservoir then and subsequently was quite sweet. At the same time, any vegetable growth, if it accumulates and decomposes, will give rise to an unpleasant taste. It will be asked, but if it is true that the water in the reservoir was sweet, how could the water issuing from the 54in. main be unsatisfactory? The answer is not an easy one and involves the consideration of the condition of this main. It was known that the main harboured the growth of fresh water mussels, because these accumulated on the filters, between successive cleanings, in great heaps, measuring about 30 cubic yards and estimated to weigh 8½ tons. The presence of sponge growths was also more than suspected. Now, these are living creatures which live and die, and which need oxygen for their existence. It seems probable that masses of *oscillaria* were blown by south-east winds into the outlet end of the reservoir, down the main and on to the filter beds. Probably a good deal of the growth would keep sticking to the roughened interior of the main, decompose, use up the oxygen in the water, and choke some of the mussels and sponges, giving rise to taste troubles. This explanation would account for the apparent anomaly of the water being sweet at the reservoir end of the main unsatisfactory at the outlet."

That is, apparently, exactly what had happened, and Sir Alexander states that he has no doubt that the trouble was accentuated by the progressive accumulation and decomposition of *oscillaria* in the water overlying the sand.

Remedial measures were at once taken. The main in question was put out of service and water from another source was run on to the filters, but the filtered water still had an objectionable taste. The filters were then cleaned as rapidly as possible, and that entailed "a great deal of work, considerable expense, and some anxiety, as it meant the waste of much precious water during a period of severe drought," to quote the words of the Report. The cleaning out of the 54in. main, which proved to be "a long, costly and unpleasant job," was satisfactorily carried out.

This portion of the Report concludes with sections devoted to "Iodoform Taste in Chlorinated Waters," "Meteorological Notes," "Thames Flow and Rainfall, 1929," and "Miscellaneous," in which, among others, the following matters are discussed:—"Kent Wells," "Bird Life in Connection with the Board's Reservoirs," "Value of Chemical Analysis," and "Elimination of Taste and Odour in Drinking Waters." Finally there is a section in which is given a summary of the last three annual Reports. Following these there is a series of chemical and bacteriological tables, &c. Space precludes us from doing more than make the foregoing mention of these matters.

For several years past now, Sir Alexander has subjoined to his reports detailed and pictorial descriptions of the various sources from which the Board derives its supplies of water. Most unwillingly we have felt bound not to deal with these descriptions, because, charmingly written and illustrated though they were, they were not concerned—or concerned only to a small degree—with engineering. This year he has chosen for his subject the numerous service reservoirs in the Board's system. He has given to this contribution the title of "The Sentinels of Water London," and as the subject is treated in rather more technical manner than the descriptions which have preceded it, we propose to give a *précis* of its contents in our next issue.

No less than fifty-eight geological surveying parties are now engaged in the official survey of Canada.

* These works were fully described in our issues of October 25th and November 1st, 1929.

Electrical Accidents.*

THE use of electrical energy in industry continues to extend rapidly. Although no figures are available to show precisely what the rate of this advance may be, an indication is afforded by the returns given in the last Annual Report of the Electricity Commissioners, which show that the number of units sold to consumers by electricity supply undertakings had more than doubled during the six years ending in 1928. The rate of increase at the present time is probably considerably greater. The number of electrical accidents occurring on factory premises might be expected to increase in like proportion, and it is satisfactory to note that this has not been the case. Comparison of the number of accidents occurring in any year with those occurring in the previous year does not afford a reliable indication of the real trend of increase or decrease, for which an average over longer periods is necessary. Actually the number of reportable accidents notified was slightly less in 1929 than in the previous year, being 420 against 427. The average number of accidents during the five years 1925 to 1929 is 393, whereas the average of the preceding five years, 1920 to 1924, is 363, showing an average increase in five years of 30 accidents, or 8¼ per cent.—a very small increase in view of the fact that the use of electrical energy must have increased over 100 per cent. during the same period.

Looking still further back to the period before the war, the figures are very instructive as indicating the enormous advance in safety which has come about since that time, mainly, it is believed, owing to the effect of the regulations in bringing about improvement in design of apparatus and methods of installation and working, and, latterly, to the effect of greatly increased inspection and enforcement of the requirements. For the five years 1910 to 1914 the average number of accidents was 403, actually greater than during the last five years, although the use of electrical energy was probably less than a fourth part of that in the latter period. The high-water mark was reached in 1913 with 512 accidents.

It is thus evident that whilst the average yearly number of accidents is less than it was fifteen years ago, it is now slowly rising, as is only to be expected. Compared, however, with the rate of increase in the use of electricity, it is a diminishing quantity. A like result cannot, however, be claimed in respect of the number of fatal accidents. The number of fatal cases included in the figures for 1929 is 35, as against 26 in the previous year—a pronounced increase. Here again, however, comparison of the figures for any one year with those of the previous year does not give a true indication of the tendency to increase or decrease. Taking the same five-year periods in respect of fatal accidents, the average numbers in 1910 to 1914 were 15·8, in 1920 to 1924, 20·4, and in 1925 to 1929, 25·8. It appears, therefore, that the proportion of fatal accidents is slowly rising.

In the 1925 report the number of accidents occurring on direct and alternating-current systems not exceeding 250 volts to earth was compared. In the four years ending 1925 the direct-current accidents were just double those on alternating systems, an average for each year of 172 and 85 respectively. In 1929 the number of accidents on direct and alternating systems was practically identical, 139 and 141 respectively. This alteration in the proportion is no doubt due to the fact that practically all new systems of supply are by alternating current and many of the direct-current systems have been changed over to alternating, a process which is still in progress in all parts of the country in giving effect to the scheme of the Electricity Commissioners in standardising the systems of supply. Although the number of low-pressure accidents on the two systems is identical, those on the alternating system are, unfortunately, far more dangerous to life.

The primary injuries from electrical accidents are shock, burns and eye-flash. These may occur separately or in combination. The most dangerous to life are those from or including shock. In the report referred to it was shown as regards low-pressure accidents that for the four years ending 1925 the proportions of these injuries were, from direct current, shock 11·6, burns 81, and eye-flash 7·4, and from alternating current, shock 61, burns 37, and eye-flash 2. Of the direct current shock accidents 2½ per cent. only were fatal, but of the alternating shock accidents 25 per cent. had fatal results. The returns for 1929 are very similar. Of the 139 direct-current low-pressure accidents the main injuries were shock 14, burns 113, eye-flash 12, and of the 141 alternating-current accidents 97 were shock, 42 burns and 2 eye-flash. Of the direct-current accidents—250 volts or less—none were fatal, whilst of the alternating 21 proved fatal. It is thus evident, as alternating current is coming more and more into general use, that it is becoming increasingly important to guard against the possibilities of persons receiving a shock.

Of the 420 accidents, 43 occurred on high-pressure systems, 12 of them being fatal. Of these, 29, including 9 fatal, were on premises of electricity supply or traction undertakings. With few exceptions they occurred to skilled persons. Eleven were due to assistant engineers or switchboard attendants thinking that the sections of switchboards or conductors on which they were about to work were dead when they were not, the mistakes being due mostly to carelessness in omitting thoroughly to investigate the conditions. Three of them were caused by the men, when about to work on switchgear, attempting to attach the "safety" earth connection to the conductors, without having first isolated the section. One was due to an assistant engineer opening an isolating switch on a feeder circuit whilst the oil switch was closed.

Several accidents occurred to contractors' workmen in erection of new or extensions to existing switchgear. In one case the man engaged in fitting up some new switchgear in a large power station wished to look inside a corresponding cubicle of the existing switchgear to see exactly how the apparatus was arranged and applied to the shift engineer to open one for him. The shift engineer opened the door of a cell—a large one—and the man entered. The shift engineer drew his attention to an insulator and struck a match so that he could examine it and an explosion followed. The contractor's man, although very seriously burned, was not killed. The shift engineer, a man of long experience, had in a moment of forgetfulness, or mental aberration, opened a live cell, 33,000 volts, instead of a dead one. The mistake is the more remarkable in that the cell was in connection with a generator, and there were only two generators in the station, only one of which was running. Incidentally, the mistake led to the shutting down of the supply over a large industrial area and involved several thousands of pounds of damage to plant in the station. Further, there was no need to have opened any cell at all, as detailed drawings of the whole of the work in hand were available in the contractor's office on the works.

Ten accidents, including three fatal, were due to the men themselves or those in charge of the work deliberately taking risks. In one fatal case, at an outdoor sub-station, men were removing overhead lifting tackle which had been temporarily erected, necessitating approaching 33,000-volt conductors. One of them slipped and made contact. There was no reason for taking the risk, as the conductors in question could have been made dead without in any way affecting the working of the sub-station at the time. Another fatal case was due to working at a dead high-tension switch cell having a live cell below it from which the screen had been previously removed and not replaced.

Totally unwarranted risks, in contravention of the regulations, are sometimes taken by employees of electricity supply undertakings with the connivance of their superiors in order to avoid interruption of the supply for a short time to perhaps only quite a few consumers. In a small sub-station it was decided to put in an additional meter, necessitating the connecting of a potential transformer to the high-tension switch fuse board. The switch fuses were drawn out, thus shutting down the supply from the sub-station, but to make the board dead and safe to work upon involved shutting down three or four other small sub-stations. In order to avoid this the workman had to make the connections behind the board, which was only about 6in. from the wall within a few inches of bare live terminals—2800 volts. Almost inevitably, he met with an accident, and was severely burned on the face, hand and arm. He was fortunately standing on a rubber mat or he would probably have been killed.

An accident of an unusual kind occurred to a switchboard attendant when engaged in opening an isolating switch on an 11,000-volt switchboard in a generating station. The circuit was a heavy one; the isolating switches consisting of three blades per phase. He had successfully opened those on one phase by means of the ordinary type of isolating pole, a metal hook and socket attached to an insulating rod. The blades of the isolator on the next phase proved stiff and he obtained the assistance of another man to help him pull on the rod. He himself held the rod only some 12in. or 15in. from the brass socket, the second man grasping the rod further down. Apparently they did not pull together and the switch blade opened suddenly at a moment when the first man was not expecting it, with the result that the rod slipped through his hands, bringing the brass socket, which was then live, in contact with his hand. The floor was composed of concrete so that he was not insulated from earth. As a result of the accident he lost an arm. The obvious precaution against such an accident is to provide an insulating disc on the rod between the operator's hands and the metal socket. This has now been done on all the isolating rods on the undertaking in question, and further guarding of isolators which may be within reach of the operator is being carried out.

Several accidents, including three fatal cases, were due to reliance being placed on insulation of conductors by means of tape. When new and unstretched, a single thickness of tape may withstand puncture tests by pressures of several thousand volts, and it is assumed that a number of layers will withstand a correspondingly increased pressure. In practice, however, in applying the tape it is considerably stretched, especially as it is generally used in covering joints, and is thus strained over more or less sharp corners, such as of brass ferrules or cable end sockets. Under such strain the resistance to electrical puncture may be reduced a hundred fold or more, making it quite unreliable and the taped joint quite unsafe to touch.

A fatal accident occurred in a large sub-station due to the explosion of an oil switch. A man working about 6ft. away was so severely burned that he died the next day. The explosion was not due to the usual cause in such cases, *i.e.*, the failure of the switch to break circuit on overload or a fault, but to failure of a part of the mechanism whereby the switch was making a bad contact and heating up in normal working, leading eventually to failure of insulation and explosion.

Two accidents, one with fatal consequences, again illustrate the risks of employing unskilled persons to clean electrical apparatus. In the fatal case, the cleaner was set to dust down high-tension switchgear of the completely protected ironclad type. One of the switches had been racked out of contact with the bus-bars and was itself isolated and dead. The bus-bar contacts from which the switch was disengaged are automatically protected by metal shutters or flaps which are held in position by springs requiring a pull of 10 lb. or 12 lb. to open them. These protecting flaps could be padlocked in the closed position, but it was not thought necessary to do this, the man, it was stated, being specially warned not to open them. Evidently, however, he did open a flap and presumably started to clean the insulator within. The result was a short circuit, causing severe burns from which he died two days later As a result of the accident the electricity supply of an important industrial area in London was cut off for half an hour.

In the other case, which was not fatal, a labourer was instructed to brush down the back and top of the slate panelling of an old type high-tension—2000-volt—open cellular switchboard. Having done this, he proceeded to brush inside one of the cells and made a short circuit from which he was severely burned.

A serious fire at a large power station, causing a complete shut-down of the electricity supply in a large city, again draws attention to the design and layout of cable trenches and passages so that escaping oil from transformers or switchgear shall not be able to extend the fire beyond the immediate apparatus concerned. In the case in question the failure of a terminal bushing on a 33,000-volt transformer led to burning oil running into a cable passageway and to the destruction of certain main cables and pilot cables, rendering the switchgear control circuits inoperative. Incidentally, attempts to extinguish the fire by "foam" proved unavailing.

Of the low-pressure and medium-pressure accidents sixty occurred to men, mostly described as "electricians," when working on live switchgear or other live conductors. In most of these there was no need to carry out the work whilst the conductors were live. Twenty-eight accidents occurred at fuses, or distribution fuse boards. One hundred and three accidents, five fatal, occurred with portable apparatus, or flexible cables and connectors used therewith. One fatal case was due to the use of an unearthed ordinary metal lampholder as a portable lamp and another to an unearthed cargo cluster fitting, a fault in one of the six lampholders causing the whole fitting to become live. In the latter case an earth wire had originally been provided, which was quite separate from the flexible cable supplying the current, but had become broken and had not been repaired.

It is interesting to note that employers of labour outside the scope of the Factory Acts may be held liable for the use of dangerous apparatus. At an engineering undertaking, not covered by the Act, a man was killed by a shock from a hand lamp of a type which does not comply with the regulations. The widow obtained £1600 damages in an action against the employers.

Two fatal accidents were due to the use of bakelite lampholder adaptors as connectors for joining lengths of flexible wires, the bakelite shell becoming broken, in one case apparently by being knocked against a girder and in the other by being dropped on a concrete floor. Two accidents, fortunately not fatal, were due to persons wrongly connecting three-pin plugs so that the casings of electric drills were made live. Some patterns of three-pin plugs in general use are found to be unreliable as regards the earth connection. On the plug being moved about when fully home in the socket it is found that the earthing connection can be made and broken and that it can remain in the disconnected position. This is a very important matter as regards connector plugs used for portable apparatus, which, although they are apparently earthed, may not be so at all.

One firm using a large number of electric tools on alternating current has experienced much trouble in this respect. At its suggestion experiments were made to ascertain whether, with specially wound motors, it would be practicable so to reduce the voltage of the circuit that danger from shock would be so remote that the earth wire might be dispensed with. It was agreed that the tests should be taken under as severe conditions as may often occur in practice, *e.g.*, the workman, as on a wet day, having damp boots and standing to his work on iron floor plates. The case of a drill weighing about 20 lb. was connected to the circuit, which had one pole earthed. The man, a specially big and strong one volunteering for the purpose, held the drill in the usual way. Owing to its weight he was bound to make a very good contact. The pressure was gradually raised from zero, but before it reached 25 volts the man shouted that he had had enough. Although with dry boots nothing whatever could be felt at that pressure, it was clearly demonstrated, and confirmed by further trials, that under these conditions, which might at any time prevail in practice, the proposal was impracticable, that is to say, however low the pressure within practical limits, it is necessary, with alternating current, to retain the earth wire.

Once again a fatal accident was due to the use of an old type screw socket lampholder. Many people do not yet realise the danger of this type of lampholder, where the metal screw of the lamp cap is in direct connection with the circuit and projects outside the holder. Skirted types of screw socket lampholders made in insulating material are available and should always be used. The old unprotected type, of course, does not comply with the regulations, and factory occupiers using it are liable to penalties whether an accident occurs or not. Twenty accidents, including eight fatal cases, occurred to persons making contact with trolley wires of travelling cranes.

Four accidents were due to the explosion of oil switches on low-tension circuits. A number of other switch explosions are known to have occurred, but fortunately not resulting in personal injuries. It is not generally realised that switch explosions are now reportable as "dangerous occurrences," even when no one is injured. Failures of switches and automatic circuit breakers appear to be on the increase and are likely so to continue, not only on electricity supply distribution systems, but on consumers' premises. Much of the switchgear now in use both on high and low-pressure circuits which was no doubt adequate for the purpose when put into commission is no longer so owing to the vastly increased power now behind it and the enormously increased possible short-circuit current with which it may have to deal, a condition intensified in many places by the linking-up of large electricity supply systems.

Where the conditions of the supply are thus rendered much more severe it is very important that the electricity supply undertakings should ensure that, not only their own sub-station switchgear, but also the consumers' main intake switchgear is of a capacity capable of dealing with the conditions. At the present time there are few large consumers who know what the capacity of their switchgear really is, and few electricity supply authorities who are able to tell them what it should be in view of the possible short-circuit conditions obtaining at the particular spot. This is a matter which demands much more careful attention than has hitherto been necessary.

Nineteen prosecutions were taken, mostly arising out of accidents. Six were in respect of electricity supply undertakings—three local authorities and three companies. Twelve were in respect of other factory premises including steel works, dockyard, sugar factory, and laundry, and one was against a workman—works electrician. Penalties varying from £1 to the maximum of £100 were obtained in thirteen cases, in one costs only, whilst four were dismissed. In two of these appeals are pending.* The work-

* Abstract of Report of Mr. G. Scott Ram, Senior Electrical Inspector.

* In one of them, the appeal has now been heard, and the High Court has referred the case back to the magistrates with instructions to convict. It referred to a fatal accident due to a man working on a dead cable within a foot or so of a joint in a live 6600-volt cable protected only by taping.

man was convicted, but let off with a caution and payment of costs only. The £100 penalty was against a local authority, in respect of the protection of high-tension conductors in a sub-station by taping only. Previous warnings had been given and the neglect resulted in a fatal accident.

The Electrical Inspectors have been very fully occupied in their respective areas, and their reports contain many useful comments on the matters dealt with, which cover a range from power supply and the making of steel to the gilding of silk fabrics and the ageing of wine. Some of their most useful work has been accomplished in regard to new plant by getting into touch with consulting engineers, power supply engineers, manufacturers of switchgear, &c., and with contractors, before the work has commenced and thereby preventing the repetition of faults previously found in other similar undertakings.

One of the matters which has again occupied attention has been that of outdoor transforming stations. As reported last year, many of these have been put up regardless of the safety of those who subsequently have to operate or maintain them and quite contrary to the requirements of the regulations. The designers of some appear to have assumed that the regulations would not apply nor the question of safety matter at all just because they are out of doors in the open air, whereas Section 149 (5) of the Factory Act of 1901 expressly provides to the contrary.

With the usual indoor types of high-tension switchgear the conductors and apparatus are completely enclosed so that ordinary routine operation can be carried on without the possibility of touching any live conductors. The switchgear is also capable of being divided into sections, any one of which can be made dead before opening up for cleaning or repairs, the live sections remaining completely screened. With the outdoor type of switchgear provision for operation without risk of touching live conductors can be readily effected by placing all conductors and apparatus at a sufficient height from the ground, or from any working platform, to be well out of reach. The further question of safety when cleaning, painting or repairs become necessary requires very careful consideration which it has not always hitherto received.

In some cases it is practicable to erect screen work between sections which can be made dead, but such screen work has its own disadvantages in that it may be difficult to arrange for and will itself in time require painting and repair. In the absence of suitable screen work, the obvious and only precaution which is available, if as is usually the case, it is desired that cleaning or other work may be carried on without making the whole station dead, is so to space the sections from one another that a man working on a section which has been made dead will be so far out of reach of any live conductor of an adjoining section that he is in no danger therefrom.

Railway Carriage and Wagon Wheel Lathe.

THE necessity for higher speeds of production than have hitherto frequently prevailed in railway workshops has caused railway officials to look very closely into the question of machining and loading times, and in the wheel lathe of which we give illustrations herewith, both of these points have been given the fullest consideration. The lathe is one of three which have been constructed by Hulse and Co., Ltd., Manchester, for the Swindon works of the Great Western Railway, and has been in successful use for some time. As will be seen, one of the outstanding features is rigidity, the bed being a deep and heavy casting in one piece and carrying both headstocks, saddles and motors.

The fast headstock extends across the full width of the bed and carries the reduction gear for the motor, which drives a longitudinal shaft inside the bed. This shaft drives an auxiliary shaft in each headstock. These auxiliary shafts carry the face plate pinions. In this way an additional reduction is introduced between the longitudinal shaft and the face plate, and the torque on the long shaft is consequently reduced. All the gearing is generated to ensure smooth running. The rotating spindles in both headstocks are hollow. The inner sliding spindles are operated by springs and automatically adjust themselves to the collets on the axle journals. The movable headstock is traversed into position by a separate motor driving through a friction clutch, which slips when the drivers come into contact with the wheels. Different rates of feed can be obtained ranging from eight to two cuts per inch.

The facilities for loading and unloading the work incorporated in the machine are of special interest and are designed to eliminate manual effort as far as possible.

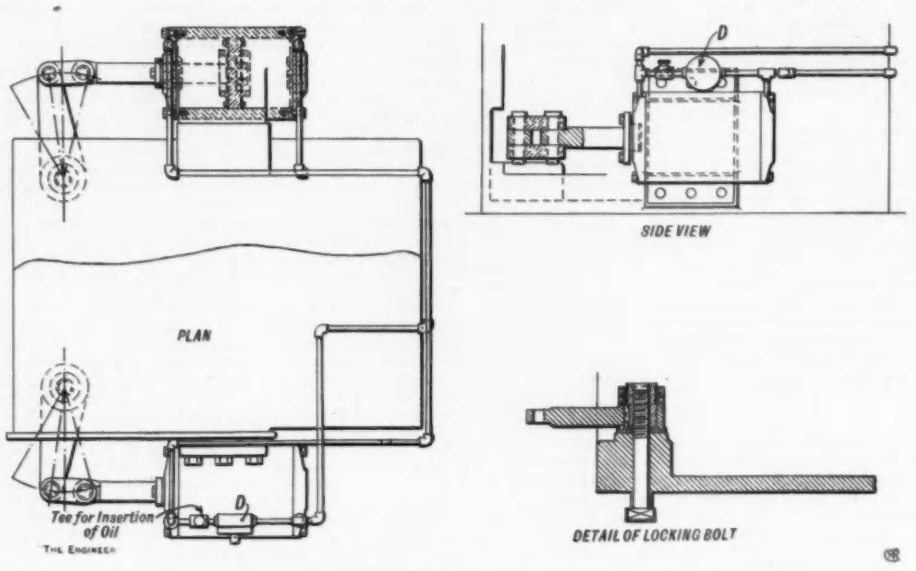


FIG. 1—PNEUMATIC CLAMPING ARRANGEMENT FOR MOVABLE HEADSTOCK

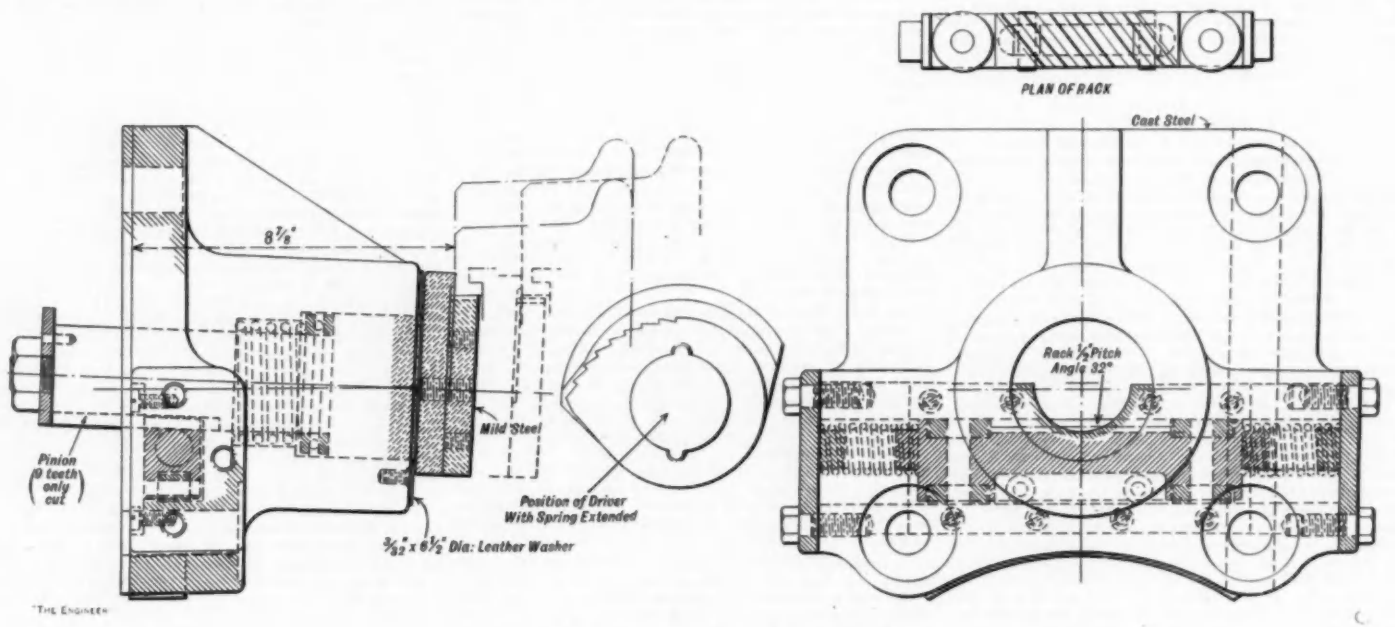


FIG. 2—SERRATED CAM AUTOMATIC DRIVER

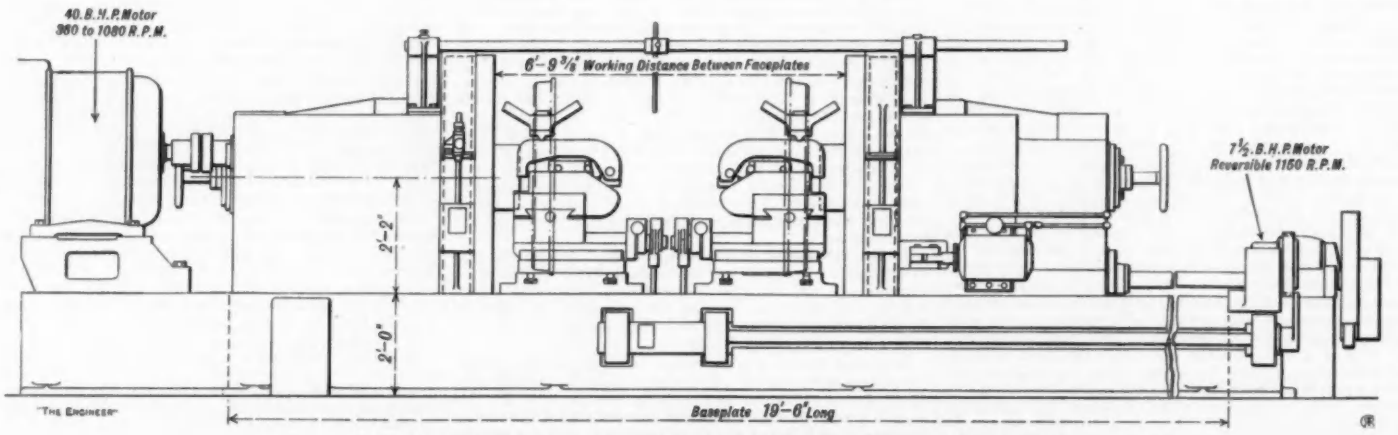
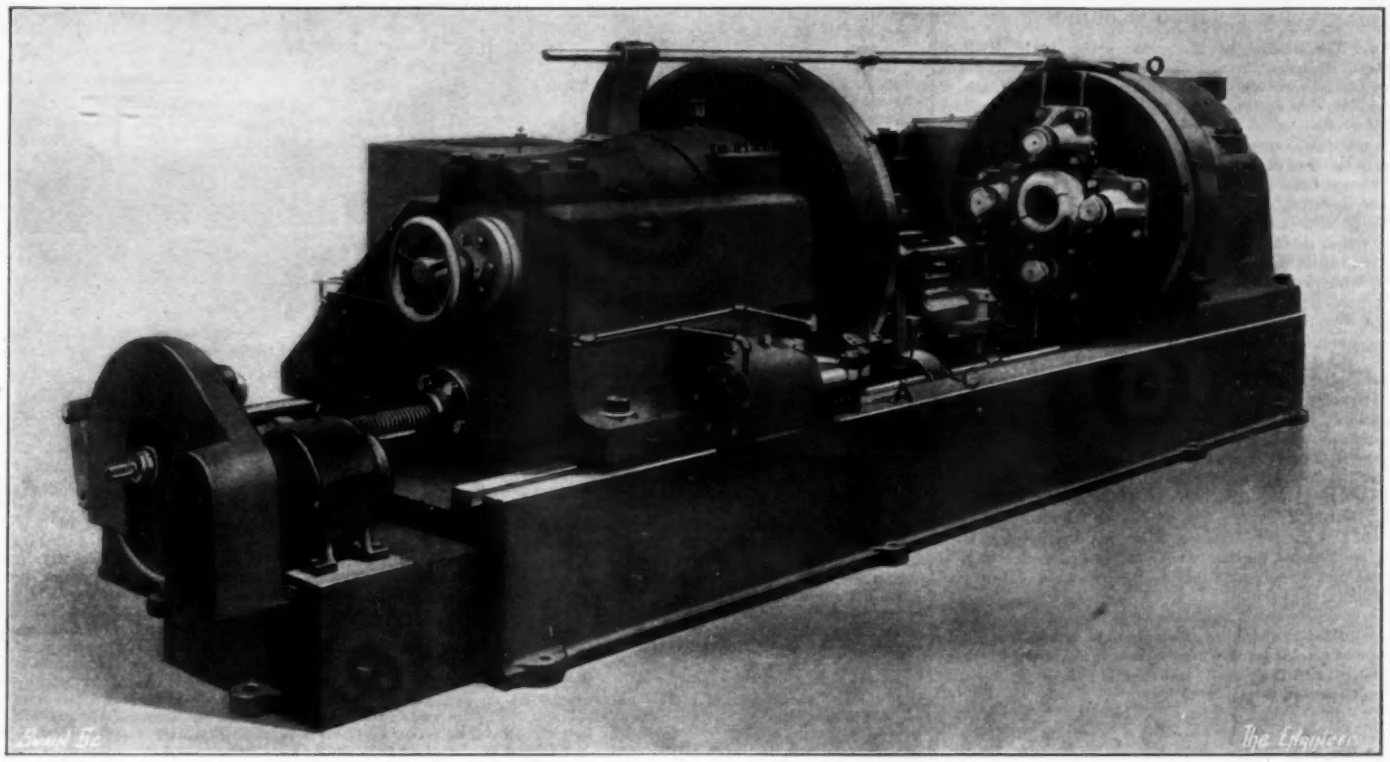


FIG. 3—GENERAL ARRANGEMENT OF RAILWAY WHEEL LATHE FOR SWINDON

RAILWAY CARRIAGE AND WAGON WHEEL LATHE

HULSE AND CO., LTD., MANCHESTER, ENGINEERS



The time required for removing a pair of wheels from the lathe and putting another pair in position has been reduced to two minutes. The only manual operation required in loading the lathe is to place the split collets on the axles and roll the wheels on angle irons resting on the bed and extending on to the shop floor. The wheels are then raised by a hydraulic cylinder under the slide shown at A in the general view—above—and the movable headstock is traversed forward by power centring the wheels and bringing the eight drivers—the details of which are shown in Fig. 2—into driving contact with the inside lip of the tire. The movable headstock is then clamped to the bed pneumatically by means of the air cylinders shown in Fig. 1, which operate on two bolts as shown. To unload the headstock the clamping bolts are released by means of a single valve D—Fig. 1—and the movable headstock is traversed back, which operation brings the wheels into the correct position for rolling out by means of a lever C shown above, which is connected to the moveable headstock by a bar. Simultaneously the hydraulic lifter is raised to support the wheels, and on being lowered again the wheels are brought on to the angle iron for removal.

The cutting tools, to facilitate tool changing, are clamped on the slides by means of pneumatic cylinders in the top rest. Adjustment for various depths of tools is provided by screws and handles. The general construction of the pneumatic clamp for the movable headstock will be followed from Fig. 1. The locking nuts on the bolts in the lathe bed are rotated by levers coupled to the pistons of the air cylinders and are adjusted for wear by means of other lock nuts. The automatic drivers were developed in conjunction with the engineering staff of the Great Western Railway Company. Each comprises a driving cam serrated on its outer surface and fitting under the lip of the tire. This cam is fitted on a stud which, at the rear end, has a spiral pinion meshing with a rack with inclined teeth. Before the machine is loaded the cam and stud occupy the position shown by the dotted lines, but when the movable headstock is brought up to the working position the driving cams and studs are pushed back against the pressure of a spring to the position shown in full lines. As a result the cams are brought into contact with the tire by the rotation imparted to them by the inclined teeth of the racks as they are pushed in. The racks are carried on rollers and are capable of endwise movement against the pressure of springs when the action of the drivers reaches its full value before the drivers are pushed completely home. A good feature in connection with this method of driving is that there are four driving points per face plate instead of two or three, as is sometimes the case. It is claimed that any tendency to buckle the wheel is, as a consequence, obviated.

Bengal Smoke Nuisances Commission—Annual Report.

We give below some excerpts from the report for the year 1929 of the Bengal Smoke Nuisances Commission, which has just reached us :—

Calcutta Air Unfit for Human Consumption.

The air we breathe in Calcutta is polluted and stagnant and in some districts for long periods is unfit for human consumption. Calcutta's respiratory diseases cause the largest death-rate from any single disease and over half the deaths amongst babies. Experts state that in congested towns there can be no real public health with bad air conditions. A recent smoke report on a large town brought out that in the districts where the smoke was worst there were the greatest number of practising medical experts for respiratory diseases. It is said one can live for many days without food, for a lesser number without water, but only for a few moments without air.

Favourable climatic conditions are most important. Where the wind velocity is about 12 miles an hour, it moderately scavenges the air pollution. Below this, means must be taken to clean the air. In another report the smoke authorities described the excellent results secured, notwithstanding the average wind velocity is only 6 miles per hour.

The average wind velocity in Calcutta is about 2 miles per hour, and for months it fails as a scavenging agent, with tragic results. In the 1927 report, the respiratory death-rate and the wind velocity plotted together showed that when the wind failed and the stagnant air thickened with impurities, the deaths vaulted from 80 to 240 a week.

The controlled black smoke from factories, steamers, &c., has been reduced to a few thousand minutes a day, which being usually discharged from lofty chimneys is dispersed overhead and the damage to some extent is reduced. But the uncontrolled 1½ million minutes a day of domestic and kindred smoke is discharged at ground level where it causes maximum damage, increases the death-rate, reduces public health, and invites other diseases.

When passing through the trials of the hot season, everyone looks forward to the cold season, hoping to be toned up. Unfortunately, at this period the aerial scavengers fail. The stagnant air during the evening is filled with domestic smoke and fumes. Calcutta is gassed. In such bad air conditions, the deaths from respiratory diseases jump up. In its sufferings local humanity looks forward to the healthier hot weather, when the aerial scavengers function better.

* * * *

Halving Fuel and Abolishing Black Smoke.

A fleet of twelve 10,000-ton colliers—or, alternatively, 120 coal trains—represents the half-yearly saving of coal to India brought about by the Commission's endeavours to give service to Bengal.

In the territory controlled by the Commisaion there are over 100 rice-husking mills. The procedure of the industry is as follows :—The paddy is first steamed with boiler steam, then after drying the husk is removed by machinery driven by a steam engine. About the same amount of steam is used in each operation.

The Commission has always been anxious that the paddy should be steamed with the exhaust or waste steam from the engine, as this would halve the fuel and reduce the emission of black smoke. About two years ago, it was proved that the exhaust could steam the paddy, but it appeared that under ordinary conditions the suspended oil and water would contaminate the rice and slow down production.

Operations were suspended pending the production of a machine that would purify and dry the steam.

A Hagan Corporation's exhaust steam purifier has been in operation in a local rice mill for the last five months. It separates the oil and water from the steam on the same principle that cream is separated from milk. The expectation of the Commission has been realised. Paddy is now steamed with exhaust steam in half the time. The rice is satisfactory, the fuel has been halved, and black smoke has been practically abolished. Efforts are being made to extend the use of similar machines to other mills as rapidly as possible.

* * * *

General Control by the Commission.

The object of the endeavours of the Commission is to render improving service to local humanity. The Commission kept in touch with the smoke departments, fuel, engineering and research institutions in Europe and America, and abreast of the latest progress in the scientific use of fuel and the scientific abatement of industrial and domestic smoke.

The average emission from each factory and steamer chimneys last year was the equivalent of 0·48 minute of dense black smoke per hour. This year it has been reduced to 0·3 minute, which is by far the lowest recorded, and means that the total black smoke daily emitted has been reduced by nearly 2500 minutes. When the Commission assumed control the daily emission of black smoke was 200,000 minutes. It is now about 5500 minutes.

* * * *

Methods of Detecting Excessive Smoke.

The smoke from as many of the factories, steamers, &c., as can be seen is observed from the Central Smoke Observatory ; which is fitted with a telephone and situated on the top of a high building. The others are observed from the districts.

During the year 3900 offences were reported, against 5828 for the previous year. The telephonic communications from the Observatory at the time of the offences rose from 1371 to 1463. Inspections and tests for educational purposes rose from 7002 to 8023. Statutory warnings under the Act were issued in seven cases as against twelve for last year. There have been no prosecutions for the last four years. The Commission, like other modern departments, is convinced on the long view that a broad educational and co-operative policy in the skilled work of smoke abatement generally gives the best result.

* * * *

Prevention is Better than Cure.

If a plant is correctly designed there should be no trouble in complying with the Smoke Act requirements. Under the Act it is provided that the plans for any proposed addition, alteration or reconstruction of furnaces, flues, and chimneys must be approved by the Commission.

During the year the Commission examined seventy-one plans, of which sixty-four, covering nearly all types of industrial furnaces for this and other provinces, were made in the office of the Commission. All were approved and permission to construct granted.

The total number of passenger journeys—excluding season ticket holders—taken on all standard gauge railways in Great Britain in May, 1930, was 100,723,740, a decrease compared with May, 1929, of 6,567,909, or 6·1 per cent. The journeys taken by passengers at reduced fares decreased by 5,106,805, while those at standard or ordinary fares decreased by 1,461,104. The receipts from passengers—excluding season ticket holders—showed a decrease of £793,565, or 15·7 per cent. If the London Tubes and Metropolitan District Railway be omitted, the figures show a decrease in journeys of 7,532,887, or 9·3 per cent., and a decrease in receipts of £797,827, or 16·9 per cent. For all companies the receipts from passenger train traffic—including season tickets and parcels and miscellaneous traffic but excluding mails and parcels post—were £766,027 less than in May, 1929. The coaching train miles showed a decrease of 259,445, or 1·1 per cent. The total tonnage of freight conveyed—excluding free-hauled traffic—was 26,793,739, a decrease compared with May, 1929, of 884,480 tons, or 3·2 per cent. Freight train receipts amounted to £8,648,281, a decrease of £282,664, or 3·2 per cent. The freight train miles run were 241,208 more than in May, 1929, an increase of 2 per cent. The average train load decreased from 128½ to 125 tons.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

SYDNEY HARBOUR BRIDGE.

Sir,—The closing of the great arch of the Sydney Harbour Bridge is the culmination of the most important stage in the erection of this bridge—the longest and by far the heaviest steel arch yet erected.

The event justifies us in reminding your readers that the contract was secured by a British firm and British enterprise in the face of world-wide competition, and its successful erection deserves a tribute to those who are responsible for the undertaking.

The greater part of the steel of very special quality has been rolled in this country and shipped to Australia by the Australian Shipping Conference Lines without any loss.

The contract has been carried out in compliance with the general project prepared by Dr. Bradfield, the engineer of the New South Wales Government, and displays very remarkable foresight and breadth of view in its conception.

Our colleague, Mr. Lawrence Ennis, who has been resident director in Sydney from the beginning of our operations, has had entire charge of the whole of the manufacture and erection of the bridge in Sydney. He, assisted by a most competent staff in Sydney, is responsible for dealing with the numerous difficulties which have been met with from time to time.

Mr. Ralph Freeman, our consulting engineer, and our staff in this country working under his instructions, have been responsible for the whole of the immense mass of designs and calculations for the permanent structure and the scheme of erection.

We desire to avail ourselves of your courtesy to place on record the deep debt of gratitutde under which Dorman, Long and Co. lie for the unstinted trouble taken by these gentlemen and their staffs in carrying this important and difficult work to a successful issue.

A. J. Dorman.
Hugh Bell.

London, S.W. 1, August 18th.

THE MOTOR SHIP "THOROLD."

Sir,—With respect to the paper-carrying motor ship "Thorold," described in The Engineer of July 18th, it may be of interest to explain that its service is in transporting from the paper mills the huge rolls of print paper for the daily newspapers, these rolls being ready for placing in the presses. While some of the cargo may be reshipped by rail, the particular business of the "Thorold" is to deliver the paper rolls for the Chicago *Tribune*, which is done at a dock at the mouth of the Chicago River. A hammer head or cantilever crane extends out over the water, with a hoisting trolley, which picks up the rolls and carries them back far enough to load them on to trucks, which are run into the adjacent printing plant.

A somewhat similar, but larger, vessel, the "Steel Chemist," delivers paper rolls to the dock or wharf of the Chicago *Daily News*, whose twenty-three-story building is on the bank of the river. This latter vessel, however, has two powerful cranes, which pick up the rolls from the forward and after holds and lower them on to skids, down which the rolls run to the concrete dock. There they are lowered down a shaft and transported through a tunnel under the railway, which passes under the building, and are then raised into the printing department.

August 5th. Chicago Engineer.

THE COMMERCIAL POSSIBILITIES OF THE AIRSHIP.

Sir,—In your very able article in this week's issue of The Engineer on "The Commercial Possibilities of the Airship," in which you draw comparison between the running costs of an ocean liner and an airship, you do not deal with the depreciation necessary on the capital outlay, owing to the difference in the life of the two vessels. An ocean liner has an efficient life of at least twenty years. What that of an air liner is cannot yet be estimated, but probably not more than three or four years, leaving aside for the moment the very much greater risk of loss of an airship than of an ocean-going liner.

I am glad to note that you refer to the fantastic calculations which recently appeared in an article in a contemporary dealing with the financial possibilities of airship routes. The premises upon which the calculations were based are so ridiculous that it is well to call attention to the fact that they are not based on any reliable data.

August 20th. X. Y. Z.

A Duplex Chimney Locomotive.

One of the results of the exchange of ideas by members of the World Engineering Congress held in Tokio last autumn is an experiment with a duplex chimney locomotive upon the Imperial Railways of Japan. The experiment is due to the initiative of Dr. K. Asakura, chief of the Mechanical Engineering Bureau of the Department of Railways. The engine was built in the shops of the Nagoya Division, under the supervision of the divisional engineer, Mr. Nagaoka, who is now superintending the tests, which are taking place on an interior line. Dr. Asakura was prompted to suggest the construction of this locomotive by the paper read by a Netherlands East Indies' delegate—Mr. P. de Gruyter—at the Tokio Conference.

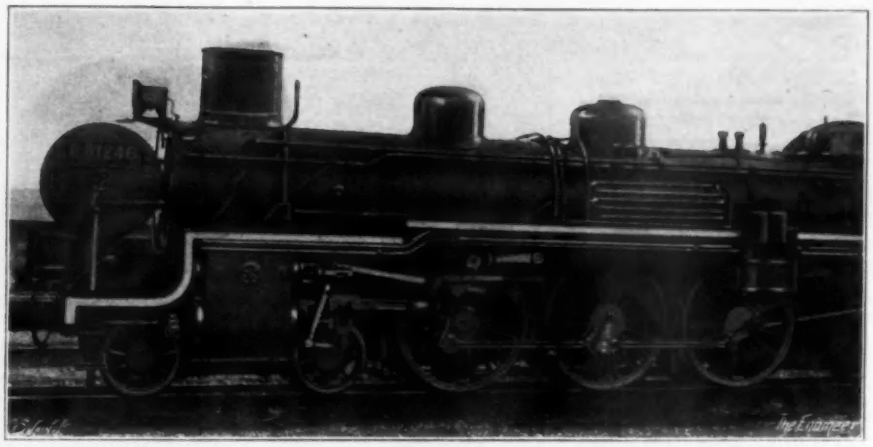
That paper dealt with road tests of a Mallet compound locomotive, of the Netherlands East Indian State Railways, an engine of the most powerful narrow-gauge type. According to the abstract of the paper prepared by the author, during the trials the locomotive was subjected to radical constructional modifications, aiming at the correction of certain typical disadvantages. In the discussion of the results of the trial runs only the more important facts concerning boiler and engine performance were included. The economy of the locomotive was much improved by the various modifications. The general results of the tests proved that in existing Mallet locomotives an increasing waste of power in throttling losses occurred at increasing speed, and that of the steam exhausted only a small percentage was necessary for the production of draught.

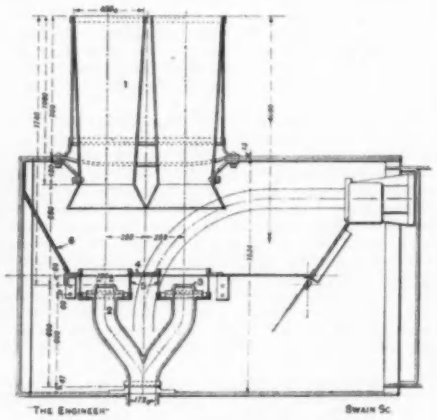
The greatest attention was directed to chimney construction, and a duplex chimney was recommended, in particular for the heavier narrow-gauge boilers, in view of the small available constructional height. The economical performance of the common Mallet locomotive would, in the author's opinion, only approach perfection with the improvements suggested. The object of Mr. de Gruyter's paper was to show, by reference to the remarkable performance of this perfected Netherlands-Indian engine, that the Mallet compound system locomotive, when adequately constructed, had still before it a long and useful tenure of service, and would maintain its place in competition with other articulated systems.

A general view of the Japanese locomotive and a section through the chimney and blast-pipes are reproduced above.

DUPLEX CHIMNEY LOCOMOTIVE

Dr. K. Asakura, Imperial Railways of Japan, Engineer





Section of Chimneys and Smoke-box

SIXTY YEARS AGO.

On the day on which our issue of August 26th, 1870, appeared events on the other side of the Channel were rapidly drawing to a climax. On August 6th MacMahon had been defeated at Wörth, and on the 14th, 16th, and 18th there had occurred the series of sanguinary engagements which had forced Bazaine to draw back into Metz. Only a week ahead lay Sedan and the capture of the Emperor and 80,000 of his troops. Our pages reflected the dominant position which the war occupied in the thoughts of everyone. We began by giving an illustration and brief description of the rifle used in the conflict by the Bavarian troops. It was a breech-loader on the Werder system, and like the Martini-Henry had a bore of ·450in. Immediately following we gave a detailed description of the Christophe-Montigny mitrailleur, which was about to be tried officially in this country. It consisted of thirty-seven steel barrels of ·534in. calibre, soldered (*sic*) together and placed inside an iron tube. A breech block holding a cartridge for each barrel closed the rear end of the gun. A turn of a handle fired the cartridges separately or as a volley. A brief illustrated description of the Maxwell 9-pounder bronze field gun for India was followed by a map and article illustrative of the defences of Paris. The fortifications at that date consisted of a chain of detached forts commanding the approaches to the capital, and within that chain an *enceinte continué* running right round the city and composed of ninety-four bastions, making up a total length of nearly 17 miles. The Gatling gun was the subject of our next article. This weapon consisted of six barrels mounted round a central axis about which they were rotated by means of a handle. As the barrels were rotated cartridges were automatically fed into them, fired and extracted. It could fire up to 200 rounds a minute. All three of our leading articles had a war interest. In the first we discussed the defence of our coasts and harbours. The unprotected state of the Mersey had excited the apprehensions of Liverpool and elsewhere the continental war and the possibility that even yet we might be involved in it had attracted general public attention to the subject. We debated the merits of various defensive systems, forts armed with guns mounted in Moncrieff carriages, armoured ships of the "Royal Sovereign" class, gunboats of the "Staunch" type, and torpedoes. We had a good word to say for all these methods, but were particularly favourable towards the use of torpedoes. Our second leading article dealt with Indian field artillery and the use of bronze for the manufacture of the guns. Our third discussed military breech-loaders in the United States. Then followed the introductory article of a series on Army Surgical and Commissariat Appliances. A rapid sketch of ambulance arrangements from the time of the Romans to the American Civil War was brought to a conclusion by a pointed criticism of those ladies and gentlemen in this country who at the moment were devoting much energy uselessly and ill-advisedly to the provision of aids for wounded "light-haired Dacians and black-bearded Gauls." An opportune review was given of a book by Lieut.-Colonel Chesney and Mr. Henry Reeve on "The Military Resources of Prussia and France," which consisted mainly of four essays reprinted from the *Edinburgh Review*. Finally, we published a note in which we stated that the Government was making or obtaining large quantities of makeshift Snider rifles, in spite of the fact that two years of experiment had shown the Martini-Henry to be a most successful weapon.

INLAND NAVIGATION IN THE UNITED STATES.

Although inland navigation in the United States makes but little development, except for the heavy traffic on the Great Lakes, some large industries have availed themselves of routes made practicable by the Government and have their own private floating equipment, independent of the general transportation lines. An example of this is the service operated by the Tennessee Iron and Steel Company for the transportation of its product from the works near Birmingham to the Gulf port of Mobile, 500 miles, for shipment to foreign and coast ports. A 20-mile railway extends from the works to a point on the Warrior River, where a 25-ton gantry crane straddles two sidings and has a cantilever extension projecting over the water. The hoisting trolley picks up loads from the railway cars, runs them out and lowers them into steel barges, 140ft. by 25ft., carrying 600 tons on a draught of 7½ft. There are eighteen locks on the river, all 285ft. long and 52ft. wide, with 8½ft. of water on the sills and a lift of 32ft. For coasting service, deeper barges are used, carrying 550 tons in the river or 700 tons at sea. On the river, the barges are handled by twin-screw tunnel type tow boats with Diesel engines of 800 H.P., controlled electrically from the pilot house. These boats have the same length and beam as the barges, and a draught of 7ft. A stern-wheel tow boat has Diesel engines of 400 H.P. A "tow" consists of seven barges, with the tow boat lashed between two of them—one on each side—and pushing the fleet, all boats lashed together. The trip takes about five days downstream and six days upstream. For the coasting service single-screw tugs with triple-expansion engines of 850 H.P. are used, handling river barges and also sea-going barges, 260ft. long, 44ft. beam and 20ft. deep, with a cargo capacity of 2600 tons on 17ft. draught. Each of these large barges has two 15-ton derricks for loading and discharging cargo.

Railway and Road Matters.

THE two mechanically-operated signal-boxes at the King's Cross terminus of the London and North-Eastern Railway are to be replaced by one, power-operated. Light signals are to be provided and the points actuated electrically. As a matter of historical interest it should be recorded that the first successful track circuit was installed at this point about thirty-five years ago.

RAILWAY surveys are being made by the Canadian National and Canadian Pacific railways, joint owners of the Northern Alberta Railways, to ascertain the best route to the Pacific coast from the Peace River district. They expect to have their reports completed by the end of summer, when the matter will be placed before the railway directors and the Dominion Parliament for approval of the route.

THERE was a buffer stop collision in No. 4 platform road at Liverpool-street, L. and N.E.R., on May 14th last, when thirty-two passengers complained of shock or injury. The report thereon by Lieut.-Colonel Anderson, issued on August 15th, records that the driver made a brake application sooner than was necessary, and in order to reach the water column he released the brake too late to make a fresh application in time to stop short of the buffers.

ON the evening of August Bank Holiday, Monday, August 4th, there was a collision on the south side of Preston Station, L.M.S. Railway. The circumstances were inquired into by Lieut.-Colonel Anderson on the 15th, when the signalman in Ribble Sidings box admitted that, although an excursion train for Leeds was still in the section, he accepted and lowered his signals for an excursion train for Birmingham. The man had just passed a fish train along the up fast line, and he suggested that that confused him.

THE Horwich correspondent of the *Manchester Guardian*, writing in that paper on August 16th as to forty further men being discharged from the works there, says: Officials at Horwich have been told definitely that no new engines are to be built at this depôt after next year. The works, they are informed, will be used for the repair of engines only. This year twenty engines are being built and twelve are ordered for 1931. In an interview, a trade union official said that it did not follow that because Horwich was to be given no new engines to build after 1931 that there would be less work at the centre. "Repair work can keep us just as busy, provided we are given sufficient engines to deal w th," he added.

THE Warren-street station on the Hampstead and Highgate tube railway is to be given a corner site at the junction of Tottenham Court-road and Marylebone-road. The station itself will be unaltered, but it will be reached by escalators instead of lifts. The work will cost about £250,000. Chancery-lane station is to have its booking offices on a sub-surface level and escalators are to be provided there and at Edgware-road. At Hampstead the station is 180ft. below street level and is the deepest on the Underground system. Escalators are hardly practicable there; high-speed lifts are better for conveying passengers quickly. The present five lifts are, therefore, to be changed for others with a higher speed.

IN this column of our issue of May 10th, 1929, attention was drawn to the fact that Parliament had just approved of the unusual step of allowing a railway to pass over a highway at Hayes, Middlesex. The work has now been completed, and has the further unusual feature of having the roadway protected by four hinged barriers, which normally are raised clear and are lowered when the railway is to be used. Such a form of protection is contrary to the Act of 1845, and to the requirements of the Ministry of Transport, as they call for gates which shall, when open for road traffic, fence off the railway. Gates could not, however, readily be provided, as the highway is about 90ft. wide, and the railway only about 15ft. The barriers have been provided by the Westinghouse Brake and Saxby Signal Company.

THE Windsor–Detroit tube, the first vehicular tunnel connecting Canada and the United States, which was brought to the point of practical completion by breaking through the barricade, 74ft. under the Detroit River, on July 14th, will be formally opened for traffic in November. The tunnel is just under a mile in length and will accommodate three lines of vehicles, although originally intended for two. The tunnel roadway is 21ft. wide, and the clearance from road bed to ceiling about 13ft. The tube will be kept ventilated by a system of fans in ventilation buildings on both sides of the river. Until the completion of the Ambassador Bridge last year, traffic between Detroit and the Canadian border cities was handled by ferry steamers. Now there are two great international traffic ways to provide for the annually increasing vehicular traffic at this point between Canada and the United States. The capital expenditure on each of these great undertakings, the bridge and tunnel, may be roughly placed at 20,000,000 dollars.

THE Provincial Government of Buenos Aires has entered into a contract with the Credito Ferrocarrilero—a locally organised syndicate representing both Argentine and foreign capital—for the construction of a branch line on the Azul-Bahia Blanca railway, which will provide a second line between the ports of La Plata and Bahia-Blanca, a distance of 697 kiloms., say, 433 miles. This branch will form part of the Ferrocarril Provincial-de-Buenos Aires la Plata-Azul system—approximately 352 kiloms., say 218 miles, in length. Although construction material has been ordered and preliminary work has been begun, it is possible that the route may undergo some change in view of strong representations made to the Ministry of Public Works by vested interests, which point to possible harmful competition with their newly constructed line and which was built under a concession granted by National Congress as recently as September, 1926. The construction on the new branch will be for the most part through a flat prairie and slightly rolling region, with neither high hills nor large rivers to be crossed, the maximum height of rail being 105 m. above sea-level and the difference in elevation of the two termini only 75ft. Its estimated cost, together with partial rolling stock equipment, is 33,200,000 dollars (paper).

Notes and Memoranda.

A NEW type of omnibus has recently been produced by the Société des Automobiles Hiesse, of Brussels, which is designed to be operated either as a petrol vehicle, a battery electric vehicle, or a trolley omnibus.

WHAT is claimed to be the largest drop hammer in the world has recently been made by the Erie Foundry Company, of Pennsylvania. It is steam-operated and has a total falling weight of 27,000 lb. The block measures 5ft. from front to back and there is 4ft. 4in. clearance between the guides. The anvil block weighs 250 tons and was made in two pieces. The machine has been supplied to the Henry Vogt Brothers Manufacturing Company, of Kentucky.

THE chief librarian of the Hull Corporation libraries reports that a suggestion was recently made that the electric lighting of branch lending libraries should be controlled by switches accessible to the public. It is found in the Central lending library, where the public has access to the switches, that lights are sometimes left on when no longer required. At the six branch libraries, where the lending departments are smaller, it was thought better to have the switches controlled by the staff only, and this system works well.

THE number of blast-furnaces in operation at the end of July was 105, a net decrease of 28 since the beginning of the month. The production of pig iron in July amounted to 486,100 tons, compared with 563,200 tons in June and 671,900 tons in July, 1929. The production included 133,500 tons of hematite, 197,100 tons of basic, 114,200 tons of foundry, and 24,200 tons of forge pig iron. The July output of steel ingots and castings amounted to 621,400 tons, compared with 600,100 tons in June, when production was affected by the Whitsun holidays, and 804,800 tons in July, 1929.

AN editorial comment from *Power*, of New York:—"The problem of flue dust disposition, more than any other, seems to be engaging the attention of European engineers as well as American. Abroad it is so important that it is being studied on a national scale. Every known method is being tried and experience reports are being made upon bag collection, electrical precipitation, water washing and other systems. Prominent European engineers express the opinion that the ultimate solution will be by some water-washing system. One thing is certain. The genius who shall devise a simple, effective, inexpensively operated flue dust precipitator will earn the gratitude of the public and find a great demand for his wares the world over."

ACCORDING to the official returns of the Dutch Customs authorities, the exports of radio apparatus and accessories from Holland in June experienced a large decline, both in weight and value as compared with the previous month, and a very considerable diminution as compared with June, 1929. For the first half of 1930, however, the exports amounted to 4855 tons, as against 4615 tons in the corresponding period in last year, while the value decreased from 39,142,000 florins to 31,307,000 florins. The exports of incandescent lamps in June were greater in quantity and value than in the previous month, or in the corresponding month of 1929. But for the first half of this year the number exported was 22,736,600, as compared with 31,331,900 in the first half of 1929, while the value was 10,178,000 florins, as compared with 14,563,000 florins.

ANHYDRITE, the anhydrous calcium sulphate, has been considered for many years to be of little commercial value, and when encountered in the mining of gypsum has usually been considered as an impurity and discarded. Recently, however, attempts to find commercial uses for this material have produced such encouraging results that the mineral promises to become an article of considerable industrial importance. In England and continental Europe considerable tonnages of anhydrite are used in the making of ammonium sulphate for fertiliser purposes. Recent investigations in the United States and elsewhere have demonstrated that it is possible to use as much as 50 per cent. anhydrite with gypsum as a retarder for Portland cement. However, the greatest interest has recently centred in the use of anhydrite for the manufacture of commercial plasters.

THE time required to reduce lumps of iron ore of different sizes to metallic iron is, says the *Iron and Coal Trades Review*, not definitely known. If it could be shown that some ores are more resistive to deoxidation than others, the selection of ore mixtures may be studied more closely. These factors may be important in determining the most desirable sizes of ore for use in the blast-furnace. The North Central station of the United States Bureau of Mines, in co-operation with the University of Minnesota, is preparing a number of sizes of about thirty different types of iron ores on which deoxidation experiments will be conducted. The various sizes of these ores will be subjected to identical deoxidising conditions at a number of different temperatures within the range 500 deg. to 1200 deg. Cent. The analyses of the resulting materials will show length of time required to metallise various sizes of different types of iron ores.

THE Winnipeg City Council has given its approval to the proposal of the Northern Engineering and Development Company, Ltd., to construct a steam heating plant costing 2,000,000 dollars in the River Heights section of the city. The heating from a centrally situated plant of a group of buildings in an extensive area of the city is not a new proposal for Winnipeg, which has many years' experience of this form of large-scale heating. The establishment of a central steam-heating system in 1924 attracted much attention at the time, the municipal steam-electric plant being designed to perform the dual function of a stand-by power service and central heating plant. A stand-by electrical service was required in case of interruption to the transmission of hydro-electric power from the Winnipeg River. A modern steam turbine plant was installed, and the equipment included electric boilers, utilising off-peak power from the Winnipeg hydro-electric system. Pipe lines were laid to carry steam heat to buildings covering a considerable area of the business section of the city. The scheme met with success and has since been extended.

Miscellanea.

THE bricklayers' union in Chicago has raised objection to the use of hollow tiles in load-bearing walls of buildings, as is permitted under the present ordinance. It is claimed that such walls are deficient in strength and in fire-resisting properties.

DEFINITE plans for harnessing the Pend Oreille River in one of Canada's greatest hydro-electrical developments have been filed by the West Kootenay Power and Light Company, with the Water Board at Victoria, and will be considered at a public hearing.

IT is announced that an arrangement has been made whereby the tar sands of Athabasca will be exploited by means of United States capital. An option has been secured over a large area of the field and the material is to be treated by the McClave process.

IT is estimated that the amount that will be spent on construction by the Bell Telephone System of America during the coming five years will be considerably in excess of £420,000,000. The amount allocated for the present year is given as being £140,000,000, or more than thirteen times the sum to be spent this year on British telephone development, which, including Mr. Thomas's appropriation, totals £10,500,000.

PATENT rights in the United States of America in respect of the Karolus light cell have been assigned to the Radio Corporation of America, according to a Washington report. Dr. E. F. W. Alexanderson regards the Karolus valve as the latest advance in television, since it is able to produce clear figures on a screen 6ft. square. The Karolus device displaces the neon tube as the light source, making it possible to project the received light impulses at a rate of 40,000 per second.

THE official returns rendered to the Electricity Commissioners show that 786 million units of electricity were generated by authorised undertakers in Great Britain during the month of July, 1930, as compared with 732 million units in the corresponding month of 1929, or an increase of about 7·4 per cent. During the seven months of 1930, up to the end of July, the total amount of electricity generated by authorised undertakers was 6167 million units, as compared with 5830 million units for the corresponding period of 1929, representing an increase of 5·8 per cent.

SHIPMENTS of electrical apparatus, machinery, and material from the United Kingdom during July last amounted to £1,623,157, as compared with £1,703,316 during July, 1929, representing a decline of £80,159. Similar imports during July, 1930, were valued at £641,654, against £589,069 during July last year, an increase of £52,585. For the seven months of this year electrical exports were valued at £11,013,317, or £47,586 less than for the corresponding months of 1929, while seven months' imports amounted to £5,069,835, representing an increase of £1,017,761 when compared with the same period last year.

THE annual conference of the National Smoke Abatement Society will be held at Leicester on September 26th, 27th, and 28th. A programme of exceptional interest is expected to ensure the presence of many members and municipal delegates. Dr. Margaret Fishenden, the expert on smokeless fuels and methods of heating, will give a paper on this subject. The special and difficult questions arising from smoke in the iron and steel industries has recently been examined by the Sheffield Manufacturers' Smoke Abatement Research Committee, and the report, by Messrs. F. J. Bailey and E. C. Evans, will be very fully discussed.

WE hear that an exhibition of mechanical aids to education is to be opened by Lord Gorell on September 4th at the London School of Economics. Sir Benjamin Gott, chairman of the Commission on Education and Cultural Films, is to preside. The exhibition is being arranged by the British Institute of Adult Education, and nothing like it has been attempted before, as it will bring together under one roof all the various mechanical devices, from the old-fashioned "magic-lantern" to the latest talk film and television equipment that have been employed as visual and auditory aids to learning. The exhibition will show through Mr. Will Day's collection of toys and objects, dating back to the seventeenth century and even to the time of the Altamira cavemen, the history and evolution of the cinema. The public will be admitted on September 5th and 6th.

APPLICATION has been made to the Bolivian Government by a civil engineer for a concession to supply hydro-electric power by employing the outlet of Lake Titicaca and the Rio Desaguadero. The applicant proposes to divert the river's course towards the Pacific instead of, as at present, to the Atlantic, thus providing in the comparatively short distance from the lake to the Pacific coast a fall of 3700 m. The project would necessitate the construction of a tunnel 25 kiloms. long through the Cordilleras, the cost of which is estimated at 250,000,000 dollars (£50,000,000). That sum, according to the engineer, could be subscribed by the several countries of South America benefiting from the scheme. A further suggestion put forward is that the extra flow of water to the Pacific coast would make possible the irrigation of many thousands of square kilometres of land now lying barren.

IN his annual report to Kirkcaldy Town Council Mr. James C. Kincaid, gas engineer, states that last year the expenditure in the Gas Department on revenue account amounted to £29,943 and the income was £46,830, giving a gross profit of £16,886. After deductions this leaves a surplus of £1520 on the year's accounts, while the total surplus is now £12,615. The coals carbonised during the year amounted to 10,361 tons, costing £10,828. The average price per ton was 20s. 10·82d. The quantity of gas manufactured during the year amounted to 193,943,000 cubic feet, being an increase over the previous year of 9,581,000 cubic feet, or at the rate of 5·19 per cent. The average yield of gas per ton over the year amounted to 18,718 cubic feet. The net income from residual products amounted to £5889, equal to 11s. 4·43d. per ton of coal carbonised, or 54·39 per cent. of the cost, making the net price of coal 9s. 6·39d. per ton.

THE PERAK RIVER HYDRO-ELECTRIC POWER SCHEME

(*For description see page* 191.)

FIG. 5—TEMPORARY SUSPENSION BRIDGE BELOW DAM SITE. AUG. 1929

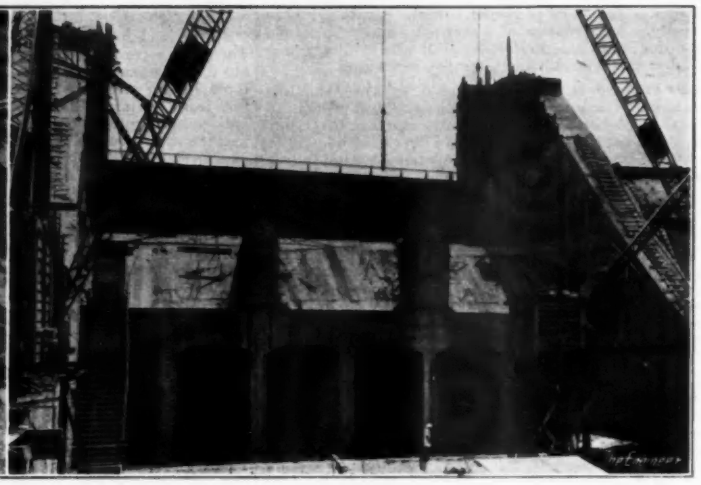


FIG. 6—SECTOR GATE DAM WITH TEMPORARY CLOSURE. JUNE. 1930

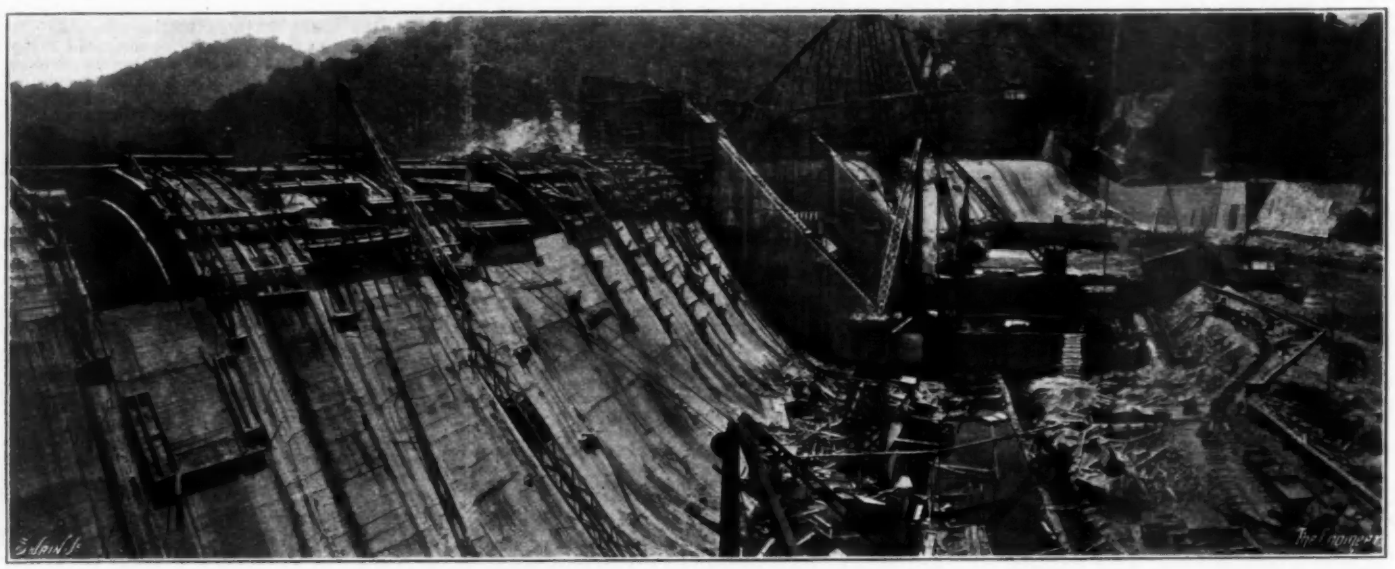


FIG. 7—DAM NEARING COMPLETION. JUNE. 1930

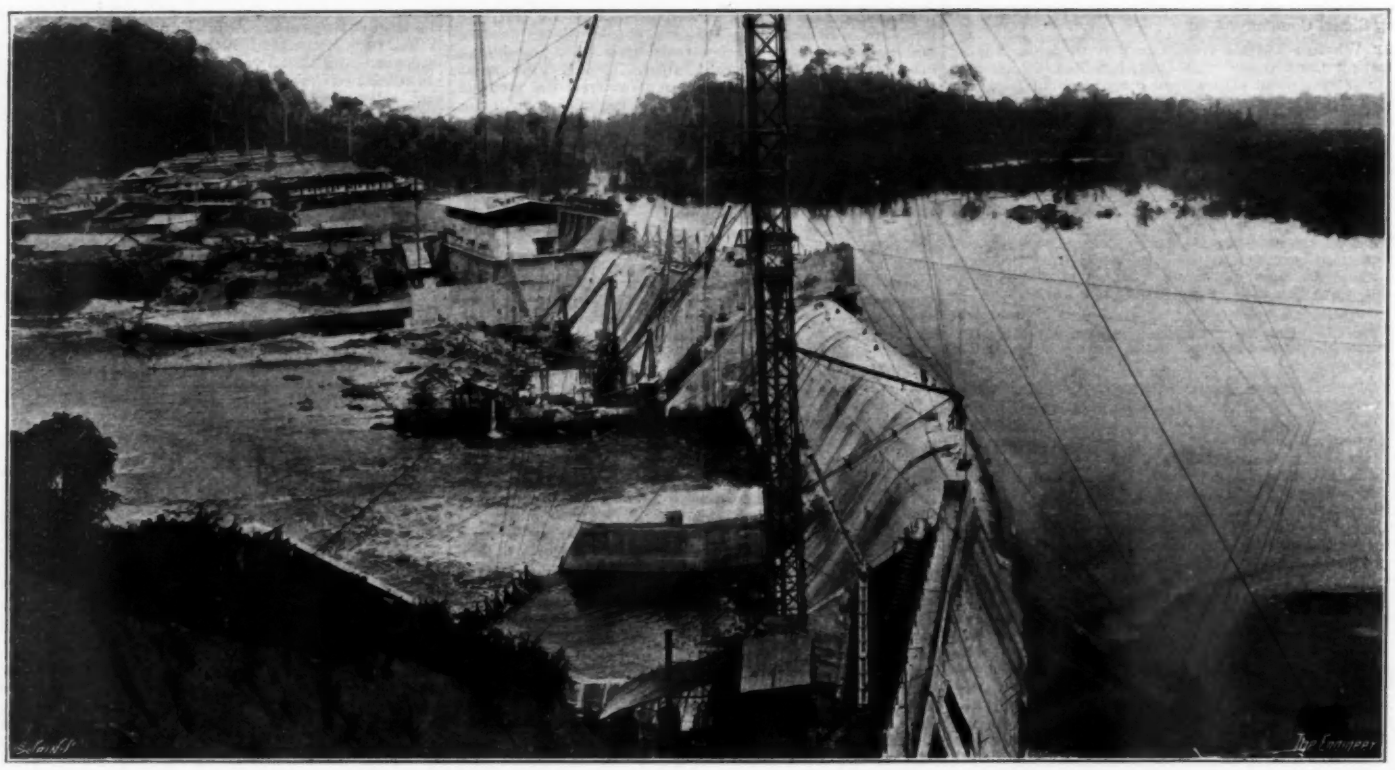
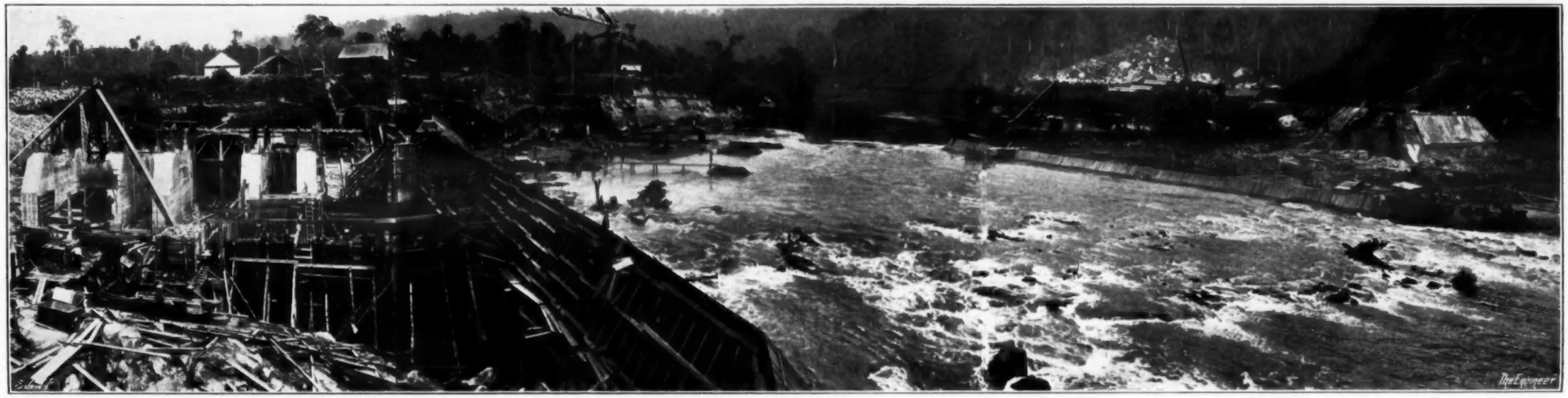


FIG. 8—A VIEW ALONG DAM FROM LEFT BANK OF RIVER. 30TH JUNE. 1930

UNIV. OF MICH.

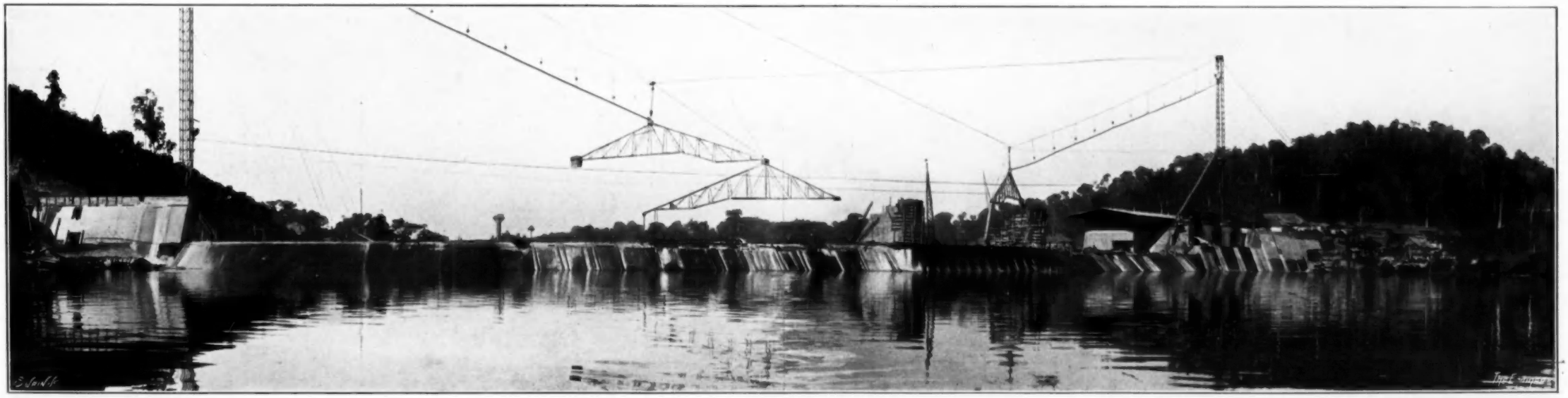
THE PERAK RIVER HYDRO-ELECTRIC POWER SCHEME

DAM SITE AND EUROPEAN CAMP AT CHENDEROH, JULY, 1927



COFFERDAMS, SOLID SPILLWAY AND FOUNDATIONS FOR INTAKE AND POWER-HOUSE, SEPT., 1928

THE DAM NEARING COMPLETION. JUNE, 1930



UPSTREAM VIEW OF DAM WITH WATER AT EL. 176'0. JUNE, 1930

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THE ENGINEER.

VOL. CL No. 3893

AUGUST 22, 1930.

Foreign Trade and Costs.

THE future prosperity of the engineering industry, like that of all other trades, depends upon the world extricating itself from present economic difficulties. It may be desirable to review what is being done to achieve that end, for the problem is one that has never before been presented to the world on such a scale, and its solution implies drastic remedies, which require a unanimity of effort that can hardly be hoped for under existing conditions of international industry. Each country is endeavouring to work out a solution in its own way. Each hopes to find a combination that will be conducive to its own interests. Therefore, while international bodies at Geneva and elsewhere have laid down the main lines of a general reform, many countries prefer to seek partial remedies. Unfortunately, this piecework method is likely to continue indefinitely, and the only hope lies in the different arrangements so far fitting together as eventually to give some stability to foreign trade. The process will obviously be a long and trying one. The only question is whether the world can await the results of this slow evolution. The difficulties have been accumulating so rapidly of late that there are indications of some broad and comprehensive policy being adopted by continental countries that may have the effect of forcing the same means of dealing with the problem on others. Most of them are groping in the dark, but some at least are working out definite plans. The most immediate need is to increase purchasing power. In Europe that power is mainly agricultural, and it has been seriously restricted by a lack of co-ordination. The idea of reorganising the industry on the Continent is taking definite shape, partly by the grouping together of the purely agricultural countries in Eastern Europe. Poland, Rumania and other wheat-producers are endeavouring to reach an economic agreement in their common interest. If this movement should succeed, it may have the effect of increasing the purchasing power of those countries, and the fact that agricultural countries are in a fair way of accomplishing what industrial nations have failed to do, may encourage further effort in this direction. An organisation of a vast agricultural community on the one hand, and a similar grouping of industrial interests on the other, should enable both of them to come to some agreement for an interchange of products. That is one of the points on which all the international committees of inquiry have agreed as forming the basis of an international organisation. The consuming countries must become prosperous before there can be any real recovery of the manufacturing industries.

Meanwhile, let us turn to Germany to see what is being done in other directions to develop business in manufactured products. That country has become a laboratory for experiment in economics. It saved the steel industry with the Cartel, and, if that institution should ultimately fail through a conflict of international interests, it will not be the fault of the Germans. The Cartel has, nevertheless, not done all that was expected of it, and the constantly diminishing consumption of goods has turned German attention to another aspect of the problem, which is that consumption can be increased by lessening prices. There is such a huge surplus production in Germany that something must be done to get rid of it. The publication of unfavourable balance sheets and the still further reduction of hours in engineering shops, show that the situation in that country is becoming critical. Therefore, the Government has taken upon itself the task of getting down prices. It reduced the prices of iron and steel on the home market and lowered wages at the same time, although not without causing considerable agitation amongst the men. Then, negotiations were entered into between manufacturers and the men for a reduction of wages which would be accompanied by lower prices, with the idea that, by selling more goods, work would be provided for the unemployed. At one time it seemed that the scheme would be carried through on an experimental basis, but the men's unions then became suspicious. They were sceptical about the good faith of employers, and the negotiations were suspended. The idea has, nevertheless, not been abandoned. The new German Cabinet has now taken the matter in hand by tackling the problem somewhat ruthlessly. Official statements lead to the belief that it will endeavour to suppress the Cartels and other groups that exist for the maintenance of prices. If the Government really carries that intention into effect, the situation is more likely to change for the worse than for the better, unless the idea is to remove the element of suspicion that stands in the way of wages reduction. Without lower wages, which will be accompanied by a lowering of prices all round, and a diminution of living costs, the suppression of the Cartels will merely let loose competition on a poor market and make the situation of manufacturers considerably worse. It will not increase consumption to any appreciable extent, because there will be no additional buying of raw material unless consumers themselves are able to benefit from lower wages and costs. Should the German Government suppress the Cartels, it will put an end to the various international organisations for distributing orders and maintaining prices at a sufficiently remunerative level. The only justification for the suppression of what, though they are not "trusts," are something like them, is that the breakdown of producers' combinations may permit of a compulsory wages reduction all round, as was done recently in the steel trade. While the Germans are doing all they can to bring down wages, costs, and selling prices, the French are in the unfortunate position of finding their charges steadily increasing. This complicates the situation in the sense that, if the Germans succeed in their policy of reducing prices, the French will have to adopt defensive measures, and there would be, in that case, a further manipulation of tariffs.

While each country is endeavouring to work out its own salvation, there is no combined effort to find a general solution, except by the formation of international unions for particular products and industries, which do nothing to foster international exchanges. No more is heard of the proposals for tariff reduction. That has never been taken seriously abroad, because, without tariffs, the efforts of certain countries to develop industries would fail. The question of tariff restrictions has been allowed to drop. Each country is looking after its own interests without considering that its interests are necessarily dependent upon those of other countries. In these circumstances, there can be little hope for British manufacturers to do business on the Continent except by carrying on a keen competition and securing privileges in consuming markets, such as is being done in Rumania. That, however, is not sufficient. Some of the most

important consuming markets are those which produce, and in some of them the increasing production costs have created a state of things that may prove of benefit to British manufacturers if they can make some present sacrifice for future profit. In France the imports of machinery and machine tools have been growing for some time past. It is a grievance of French makers that the ports continue to purchase electric cranes abroad. The margin of production costs in different countries is being narrowed down, and at the same time the Germans are getting their prices to a level at which the foreign tariffs may not stop them. That is the one crucial factor of the situation. Rationalisation has done much to effect economies, but this practice is now fairly general, so that one country does not benefit much more from it than another. Where they differ more particularly is in the living cost or standard of living, which two terms are not synonymous, because, while the standard of living implies a definite purchasing power by wage earners, the living costs are determined largely by the wages paid, as well as, of course, by fiscal charges. If living costs are lowered by a reduction of wages, the standard of living may remain unchanged. A reduction of wages, accompanied by a diminution of fiscal charges, if that were possible, would improve the workers' situation by increasing consumption and widening markets. That is the end which the Germans are seeking to attain. Interest, at the moment, lies not so much in the carrying out of more or less problematic international fiscal alleviations as in the efforts being made by Germany to determine a policy of cheap production.

Reports on London Waters.

In another column we give the first portion of a summary of the contents of Sir Alexander Houston's twenty-fourth Annual Report on the Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended December 31st, 1929. These Annual Reports of the Director of Water Examination to the Metropolitan Water Board are always most welcome. They are prepared, evidently, with consummate care, they contain a most varied collection of useful information, and while technicalities are by no means omitted, the text is so lucidly written that the layman—or, let us say, the ordinary consumer of water—can, surely, have no difficulty in reading and understanding them. As a whole, the twenty-four Reports constitute a most valuable and complete record of the investigations which have been carried out during nearly a quarter of a century in connection with the purification of water, admittedly derived from polluted sources. They describe the many methods that have been devised by Sir Alexander and others for the treatment of such waters, for combating and preventing the onslaught of water-borne diseases, for predicting and curing algal troubles, and for dealing with many other difficulties which continually confront the waterworks engineer. Sir Alexander is always most ready to give credit where credit is due, and it is rare, indeed, for one of these Reports not to contain some mention of the work being carried out by other investigators in the same sphere of study as his own.

The present Report follows very much the same lines as those of former years. Not unnaturally, a good deal of space is devoted to the chlorination of the waters of the rivers Thames and Lee. As has been made amply clear in past Reports, a considerable measure of success has attended the addition of chlorine to waters, known to be contaminated, since the process was first adopted in 1916, as a means of saving fuel during the War. With its aid, the need for the more or less long retention of the raw water in large reservoirs for the purpose of purification has, to a great extent, been eliminated. Water abstracted from the rivers is allowed to flow by gravity direct to the filters, being treated with chemicals on the way, without its having to be pumped to a height sufficient for it to be discharged into reservoirs. This relief has resulted in a very large saving in the annual expenditure on fuel and labour, at the expense of a comparatively insignificant outlay on chemicals. Moreover, the saving has been effected without in any way interfering with the quality of the water as supplied to consumers. Then, again, the question of rapid primary filtration, followed by "slow" sand filtration, receives, in this year's Report, a considerable amount of attention. The results of investigations carried out in past years in this direction have, we learn, been amply confirmed. From the Walton works, where primary and secondary filtration followed by chlorination preceded by ammonia treatment, are employed, the water, as finally pumped to consumers, contains no *B. coli* bacteria in 100 c.c. in 93·6 per cent. of the samples examined. This, it will be readily admitted, is a truly remarkable achievement, especially when it is remembered that the "slow" sand filters were passing the water through at a rate from three to four times as fast as when working without prefiltration. Furthermore, the number of million gallons filtered per acre between cleanings is greatly increased as compared with what it is with slow filters only in operation. At the Barn Elms Station, where the investigations into dual filtration were first initiated, the primary filters were, during the year under review, worked at an average rate of 141·4 gallons per square foot per hour, and the secondary filter at the rate of 4·11 gallons per square foot per hour. We must not forget to mention, as a most welcome addition to the present Report, a description of the Service Reservoirs included in the Board's system. We shall have occasion to review this portion of the volume in our next issue, so that nothing further regarding it need be said in the present instance. It will suffice to say that this account—which follows others of a similar nature, but devoted to the various sources of supply on which the Board can draw, that have appeared in successive Reports in past years—is equally as informative as they have been. It is written in the style—whimsical and humorous at times—which Sir Alexander has made quite his own.

We have on several occasions in the past remarked that it is a great pity that these Reports of Sir Alexander's, and others that are published by the Water Board, are not more widely read, than they are, by the water consumers of London. The average water user, however, does not concern himself about anything, provided that, when he turns on his tap, good, clear, tasteless water comes out of it under adequate pressure. He gives no thought as to where the water comes from, what processes it has gone through, or how many times it has had to be pumped, before it reaches that tap of his. Let that tap cease to provide him with water, however, or let him, by rare mischance, detect cloudiness, a taste or a smell in the water, and he is, at once, up in arms. Nor is it very much to be wondered at that matters should be as they are. From earliest infancy the consumers of water in the metropolitan area have been accustomed to receive, automatically as it were, ample supplies of water of extraordinary purity. It has become one of the commonplaces of the Londoner's life that water of good quality is always forthcoming. Moreover, the charge made for the water is, in most cases, so small, when compared with other items of domestic expenditure, that the amount is generally paid without a murmur or a thought. It is only on the very rare occasions when something goes wrong that the ordinary householder begins to trouble himself about the matter. We feel sure that the perusal of these Reports which are issued at intervals by the Water Board would teach the supine consumer some salutary lessons. He would learn, for example, how vast is the organisation that is necessary to furnish supplies of water to the upwards of seven million inhabitants of the "Water London" area; he would be in a position to learn what enormous reservoir capacity, what large amounts of pumping engine horse-power, what wide areas of filter beds, and what a huge network of large and small mains and distribution pipes, are needed to effect this colossal purpose. But, beyond everything else, he would be able to realise—though perhaps not to the full—the unceasing vigilance exercised, and the meticulous care taken to ensure that the water, as supplied in the area under the control of the Metropolitan Water Board, shall be of a purity which may compare most favourably—as most assuredly it does—with that of any of the large cities of the world.

Literature.

The Measurement of Hydrogen Ion Concentration. By Julius Grant, Ph.D., M.Sc. (Lond.), A.I.C. Longmans, Green and Co. 1930. 9s. net.

In these days of specialisation it is customary to make the most of every departure in science, and to ride the hobby-horse to death. For a great many years the physico-chemical literature, as an outlet for the energy of investigators, was filled with measurements of electrical conductivity of solutions, after a spell of cryoscopic mensurations. Then came applications of the phase rule, and fashion followed fashion. To-day, the determination of *p* H values is one of a number of ways of courting fame. Even the author of the book under review seems to appreciate the humour of these things in his preface, where he mentions that "the hydrogen 'I' kon worship has now subsided." In spite of the specialised character of this book the author has succeeded in giving a great deal of general interest in the first part of the volume, which deals with mensuration of electrolytic potentials.

To criticise the theoretical introduction fully would be too lengthy a proceeding, but as an example of modern logic we may take the following extract from page 5:—"An acid is a substance which in solution is dissociated into charged hydrogen ions (H′) and a negatively charged residue; a base is dissociated in solution into negatively-charged hydroxyl (O H′) ions and a positively-charged residue. It is difficult to distinguish between an alkali and a base. The former term is used in a general sense for soluble hydroxides of metals or of ammonia, whilst a base is essentially a salt-forming substance which yields O H′ ions in solution.

"These statements are to replace descriptive definitions of the early workers, &c. &c."

Now, these definitions happen to be far worse than their predecessors, as the bulk of metallic hydroxides are insoluble, and if taken up by water they form colloidal sols and not solutions in the ordinary sense, and nobody will deny that they are salt-forming bases. The previous definitions were: "An acid is a negative hydrogen compound. A base is a positive hydrate." These definitions were taught in the 'eighties of last century and said to be the end of the Berzelian oxide theory with similar remarks about early workers. Still, neither of these two views explain why chromic acid still upholds Berzelius by forming an hydro-acid salt, such as ordinary bichromate. The statement in the quoted sentences that "it is difficult to distinguish between an alkali and a base" verges on the comical, as an alkali is just *the* base *par excellence*.

These "Kathederblumen," as the Germans call them, are pretty common in this book, one of them occurring just after Sorensen's expression for the *p* H value, page 9: "To divide the hydrogen ion concentration into 1 and take the logarithm of the result may sound like a riddle." To most people the man who did such a thing would be a fool, as any tyro would put a minus sign in front of the logarithm for the ion concentration, just as the formula shows two lines higher up. Still, there is sound sense in this expression, not because it enables us to express the strength of an acid in terms of a simple number, "but because it is the true hydrogen potential in volts divided by 0·000198 T for the test liquid measured, which has a logarithmic relation to the ionic concentration according to Nernst. The derivation of the expression is given on pages 32–37, including the change from natural to Brigg's logarithms, but unless the reader knows physical chemistry fairly well he is likely to see riddles like the author.

Taken on the whole, the theoretical introduction is good with regard to scope, but it lacks precision with regard to arrangement of the matter and mode of expression.

The object of the mensuration of *p* H values is to express the "strength" of acids and alkalis in solutions in a rational way in such a manner that only the "active" part of the dissolved substances is considered. Unfortunately, the range of utility of this method is limited to a number of solutions of low "activity," mainly of physiological and pathological interest, though, no doubt, in practical electrolysis and electroplating *p* H values are highly important, but neglected. The author gives the two methods of measuring the *p* H values, viz., the electrical one and the colorometric ones, employing indicators and "buffer" solutions. Of these, the reviewer will confine his attention to the author's description of the electrical methods, as the others have only an interest to the chemist *ex professo*.

To begin with, the author describes the standard solutions and electrodes used for making the concentration cell of which the test solution is a part. Some forms of hydrogen electrodes of platinum coated with platinum black are given, and the directions for preparing calomel electrodes are quite good for working to. For practical electro-chemical work and for plant physiologists and others, the quinhydrone and the glass "electrodes" may be of interest, and descriptions of both are given. A simple arrangement of a testing cell, which is as good as any, is given on page 51. The mensuration of the cell voltage with potentiometer and standard cells follows, and some commercial instruments are mentioned. In describing one of these, the author lapses into one of his favourite remarks, viz., that a certain instrument should "only be used for the measurement of very small voltages on account of the strain on the delicate unipivot galvanometer," &c., when the instrument is used as a voltmeter. As the diagram given shows the instrument getting the battery current through an adjustable resistance, no doubt, provided by the makers to keep the voltage within bounds, and, moreover, it is stated to read up to 1 volt, this remark is hardly necessary. Besides, this a unipivot instrument cannot be damaged by any one voltaic combination known, the standard resistance of a *millivolt* meter of this kind being 500 ohms, confining the current of a "short" to some 4 or 5 milliampères at the utmost. In this connection it might be mentioned that the mathe-

matical "proof" of the Paggendorff method on page 53 and 54 is not binding, though it sees daylight periodically.

All the same, the method as described on page 63 is about as perfect as can be desired, if a high resistance galvanometer be substituted for the Lippmann capillary electrometer. The author's anxiety about the insulation is rather amusing considering the acting voltages, but his advice regarding the necessity for good connections and contacts should be taken to heart by all beginners. Mercury contacts in paraffin wax are not to be recommended, contrary to the author's advice, as they condense mercury films on the surface after a time. They are best constructed from high insulation ebonite blocks which can be easily cleaned. On the whole, the method is simple and easy in the hands of a chemist, who will use the same neatness and cleanliness as he would in preparing a standard solution once he has mastered the use of electrical instruments.

The author points out the sources of error with such a vigour that he finds it necessary to remark at the end—page 71—"From what has been written it may be imagined that the electrometric method is so limited in its safe application as to be almost useless. That is not so, &c., &c." This is a tactical mistake in a book intended for beginners, as it shakes the confidence of the reader who tries the method in practice. A chemist of to-day should be able to feel as certain about an electrical mensuration as about the weighing of a specimen, and an initial doubt or fear about his instruments and method is a severe handicap which it takes years to get rid of.

The author is certainly not hypercritical, but his summary remarks are unfortunate and unnecessary from a pedagogical point of view. It has to be remembered that the class of man who is likely to be employed in, say, an electro-plating works, to control solutions, need not of necessity have research training. Well managed, no method could be simpler or more expeditious than the electrometric one for regulating p H values in this case, and rapid electro-deposition of soft, heavy nickel deposits amongst others is an impossibility as a continuous process without very accurate control of the p H values. This has been realised in the U.S.A. for a long time, and the method will, no doubt, find extensive use here before long. The author has given page 131 to the subject, which seems very little considering the economical importance of that issue.

However acceptable the book may be to those who know all about it, as an inexpensive book of reference, the reviewer fears that the class of reader most directly concerned, viz., the works chemist, will find it irksome. It must not be forgotten that the best and most accurate routine chemists are not always well enough up in theory to follow the Nernst-Planck deduction of electrolytic potentials. Still, they use such things as the penumbral polarimeter, Abbé's refractometer, viscometers, &c. &c., from directions for use issued by the makers without any more than a trifling knowledge of optics or theoretical dynamics. If Chapters 2 and 3 had been written with a bit more detail as to actual working, even if the theoretical parts should have suffered, it would have been welcome to routine workers, who know electrical mensuration by reputation only. The very numerous literature references, so essential to the specialist, have also little value to this class of worker. In his own interest the author should have considered that particular public before undertaking such an extremely trying work as condensing all the subject matter given into some 150 pages. To the expert reader the book is extremely interesting, and, used under the guidance of a specialist teacher, it should find use as a text-book for students of the subject.

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Investigation of Mineral Resources and the Mining Industry. Being a publication issued by the Mines Branch of the Canadian Department of Mines.

Twenty-fourth Annual Report of the Bengal Smoke Nuisances Commission for the Year 1929. Calcutta: Bengal Secretariat Book Depôt. 1930. Price 9d

Forest Products Research Bulletin, No. 6: The Timber of Corsican Pine. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. 6d. net.

A Form of Coupling for Geared Diesel Engines for Land and Marine Purposes. By W. Brose. London: The Diesel Engine Users Association, 307, Abbey House, Westminster, S.W. 1. Price 3s. 6d. net.

High-power Heavy-duty Oil Engines: Development and Experiences. By G. A. Mellor, A.M.I. Mech. E. London: The Diesel Engine Users Association, 307, Abbey House, Westminster, S.W. 1. Price 10s. net.

Annali dei Lavori Pubblici (già Giornale del Genio Civile), Ministero dei Lavori Pubblici, Consiglio Superiore. Anno LXVIII. Fasc. No. 6, Giugno 1930. Rome: Provveditorato Generale dello Stato, Libreria.

Hermanns' Pocket Technical Dictionary. German–English–Italian, English–German–Italian, and Italian–German–English. Published by the author, Hubert Hermanns, 64A, Dahlemerstrasse, Lichterfelde-West, Berlin, Germany. Price 15s. post free.

Metropolitan Water Board, Twenty-fourth Annual Report on the Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months Ended December 31st, 1929. By Sir Alexander Houston. London: P. S. King and Son, Ltd., 2 and 4, Great Smith-street, Westminster, S.W. 1. Price 21s.

Obituary.

WALTER BERNARD PHELP.

His numerous friends, both in this country and in South Africa, will learn with deep regret that Mr. Walter Bernard Phelp, general manager of the British General Electric Company, Ltd. (South Africa), was killed as the result of an accident at Pontresina, in the Engadine, on Sunday, August 10th.

Mr. W. B. Phelp, who was fifty-seven years of age, was an old and valued servant of the General Electric Company. He joined the firm as an office boy, and his abilities were soon recognised. After promotion and experience at the company's head office and its branches—he was at Cardiff for several years—he was selected by the directors to found a Cape Town branch when the company decided, just after the Boer War, to establish its own branches in South Africa.

That was nearly twenty-seven years ago, and from the small beginnings of the company's enterprise at Cape Town there has been developed, under Mr. Phelp's personal supervision, a business of many ramifications, with its headquarters at Johannesburg, and with branches at Cape Town, Port Elizabeth, and Durban, and agencies in Salisbury, Buluwayo, and East London. There is no doubt that much of this development is directly traceable to him.

Mr. Phelp was a most popular chief with his staff. He possessed an infinite capacity for hard work and was punctilious in detail, and while he influenced those under him to apply themselves in accordance with the example he set, he inspired a sense of loyalty and veneration that was largely responsible for the success which attended him throughout his career in South Africa. A man with a big heart, and a sportsman in the true sense of the word, his death will be deplored by every member of the G.E.C. organisation at home and overseas.

The Tanna Tunnel, Japan.

(From a Correspondent in Japan.)

The long-expected completion of the Tanna Tunnel, of the Japanese Government Railways, has been further delayed by an accident that happened towards the end of June, when there was a cave-in and a great inburst of water. The engineers estimate that the accident will cause a delay of nine months, which means that it will be three years—such is the official estimate—before this difficult piece of engineering work is completed.

Work on the tunnel was begun in April, 1918. Difficulties were anticipated, owing to the geological conditions known and suspected, but it is doubtful if the great enterprise would have been started had the true characteristics of the area been fully known. However, it would not be fair to say that the Tanna Tunnel, as was said of the Simplon, is the grave of the geologist's reputation, for opposition was heard from more than one source before the work was begun, but the obvious economic advantage of the new route was probably a greater incentive to action than the assurances of men learned in the nature of this volcanic land.

In the years intervening since 1918 several serious accidents, entailing heavy loss of life, have occurred, but in the most recent mishap, owing to the experience gained, there were no casualties of any sort.

The object of this cut-off, which is known as the Atami Line, after the famous hot spring at the eastern portal of the tunnel, is to avoid the tortuous, many-tunnelled section between Kozu and Numazu, 37 miles, which was completed in 1889. It is worthy of note that the highest point on this section, at Gotemba Station, where Fuji climbers alight, is 1240ft. above sea level, while the highest point on the cut-off, near Atami, is only 259ft. In other words, the train rises 1200ft. in the short run from Kozu (18 m.) at the seaside, to Gotemba, and descends to Numadzu, also a seaside town, in 19 miles. There is every inducement, therefore, from an economic point of view, for abandoning the old route, which is, moreover, 7 miles longer than the new one.

But the economic advantages fully admitted, and allowing that the scenic advantages of the old line are subordinate, the traveller will suffer one great loss by the new route—the old familiar view of Fuji will no longer charm him with each passing, a view of beauty and enchantment that will never tire. Little wonder that the poets and artists of Japan for a thousand years have gone into delightful ecstasies over the "Peerless Mountain"—as peerless it is, seen from the passing train, which hugs its base for many miles—a magnificent sweep, a perfect cone, rising 10,000ft. into the blue. Like everything Japanese, Fuji must be seen and experienced repeatedly to be thoroughly enjoyed—is not that true of everything that is worth while?—and the voice of protest will be heard when, in place of the heavenly vista, the traveller is plunged into a tunnel black as night, his next view of the great mountain being but its distant, snowy summit.

But to go back to our economics. The traffic capacity of the Kozu-Numazu section will be increased three-fold by the new cut-off, the Limited Express will save thirty minutes, and the railways in the course of the year will save many thousands of yen represented by coal bills and wear and tear. All these benefits are held to justify the expenditure of over seven million sterling on 30 miles of double track, with several stations and one great tunnel. The cost of the latter is estimated at £2,600,000—£100, or 1000 yen, per foot of its length, which is 26,000ft.

Engineers attribute the recent accident to the fact that the drillers suddenly struck a great fault crossing the main island of Japan at this point, running south-north coming from the bay of Sagami and entering the Sea of Japan.

A general description of the terrain through which the tunnel is bored has been published by the Director of the Bureau of Construction, Railway Department—Mr. Eiji Ikehara—who points out that the difficulties encountered are due to a combination of three bad conditions—"many faults, great inflow of water, and soltafaric clay of bad composition."

Boring was begun at both ends, at Atami Spa, the eastern portal, and Otaka village, the western portal. Experience confirmed the geological opinion that the region corresponded to the depression crater of an old volcanic cinder cone—"there exists an alternation of lava flow, tuff and agglomerate, the dip and strike running from east to west generally, and the nature of the volcanic rock being andesite and its derivatives, such as are usually found near volcanoes in Japan."

Fears were also entertained regarding the nature of a depression, about midway, known as the Tanna Basin, under which the tunnel is pierced at a depth of about 600ft. Opinion was divided as to the cause of this depression, whether it was due to natural erosion, a crater explosion, or was caused by a fault. As the work progressed, faults were encountered, and the drillers anticipating danger, a thorough investigation was decided upon to ascertain exactly the causes of the formation of the basin. With this object, borings were made in 1926, when it was proved that the basin lies on a long, broken line running north-south, and that it corresponds to a kettle depression produced by a group of faults. The examination further showed that while many faults would most likely be encountered, the basin was not an explosion crater, as at first thought, and that excavation would therefore be carried out under more favourable conditions than was first considered likely.

Subterranean heat and humidity have not been very serious, considering the volcanic area and the prevalence of hot springs in this region. A maximum temperature of 28 deg. Cent. and 100 deg. humidity were encountered early in the work at the eastern end, but, as tunnelling progressed, temperatures were much modified by the presence of water. But that also has proved the greatest obstacle to progress, water in volume and pressure rarely encountered in such work having repeatedly almost overwhelmed the workers, causing great damage and delay.

The accident in June was due to the tapping of a huge interior reservoir. The cave-in occurred at a point 11,980ft. from the western portal, and water and mud rushed out at a rate estimated at 45 cubic feet per second, the mass of detritus blocking the tunnel being estimated at 4000 cubic yards. The torrent was brought under control, and many tons of cement injected into the area to solidify it, after which the work of excavation proceeded. The existence of this reservoir was ascertained in 1926, when a boring was made, and at a depth of 80ft. water was encountered which spurted 40ft. into the air. At this point the tunnel was to run 600ft. below the surface, and the drillers striking the transverse fault tapped the subterranean lake.

Between four and five thousand feet now separate the heads of the excavations from the eastern and western portals, but the engineers in charge are confident that the worst obstacles have been encountered and overcome.

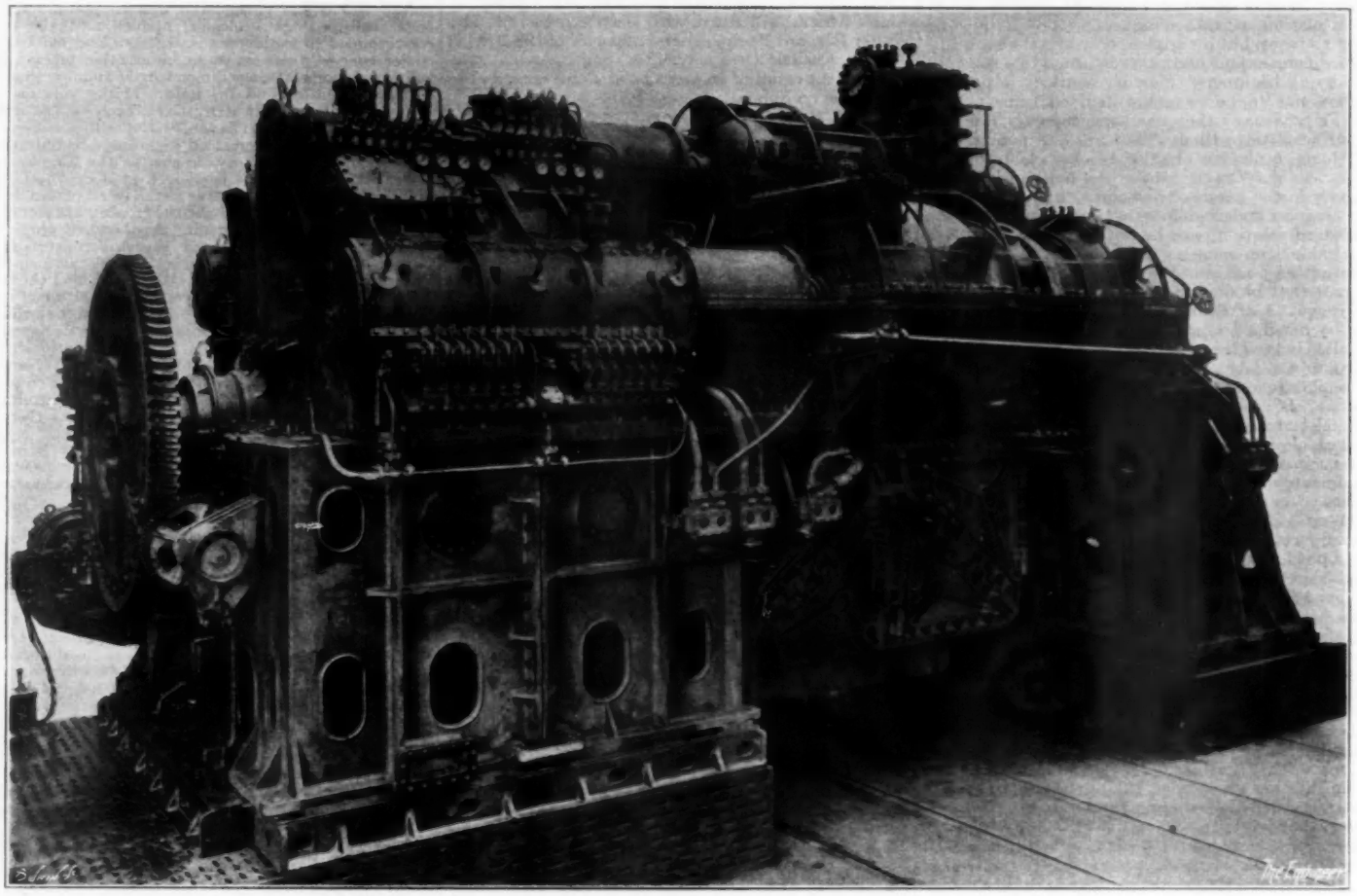
HARBOUR EQUIPMENT AT DURBAN.

Provision has been made in the Railway and Harbour Estimates for the new financial year for an 80-ton fixed electric crane to be installed at the deep-water berthage at Durban, thus removing the disadvantage that large vessels are unable to berth alongside the present 50-ton hydraulic crane. This old crane will, it is understood, be removed. The existing 15-ton crane carried on the floating workshop will also be replaced by a floating crane of 25 tons capacity. The remaining nine small hydraulic cranes at the town end of the wharves, which, in addition to being obsolete, are too low to work large vessels, are also to be removed, and eleven electric cranes provided in their stead. The new dredger will soon be due for delivery. A Priestman grab crane and barge are also to be provided to keep the deep-water berths at their proper depths; £28,000 is allowed for further reclamation work around the bay, and another £28,000 is allocated for the 300ft. extension of the South Pier, on which nearly £70,000 has already been spent. A new slipway on Salisbury Island is to replace the present one used for repairing lighters, &c., and a new landing stage will also be built. Ninety-six pound rails are to replace the old 80 lb. type, wherever advisable; £16,000 will be required for the new third-track between Durban Central and Berea-road stations, with an additional £9000 the following year. A further £20,000 will be spent on various improvements in the Durban yard, as well as the final portion of the £85,000 authorised for the Congella marshalling yard. The tracks between Berea-road and Umbilo are to be relaid and raised. A deviation is to be provided between Stanger and Tugela, and the bridge at the latter station is to be replaced at a cost of £76,000, and other bridges and culverts as far as Materbatuba will be strengthened at a cost of £26,000. Durban is obtaining considerable work on whaling vessels, which used to be all done at Cape Town, but with the increase in the whaling fleet cannot now all be coped with at that port. Consequently, marine engineering firms at Durban are at present fully occupied with repair work on the fleet of twenty-three Norwegian whalers from the Antarctic, both the graving and floating docks being in use. Nine of the vessels are equipped for oil burning, and specially designed to stand ice pressure. It is stated that the total cost of overhauling the fleet will approximate £50,000. The new harbour tug which was to be stationed at Port Elizabeth harbour was totally wrecked on the way out, off the coast of South-West Africa. The "St. Croix" was a Holland-built craft, only completed at Ambacht this year, her cost being between £14,000 and £15,000. The harbour tug "Henry Burton" is to be sent round from Durban to be put in commission at Port Elizabeth until another tug can be obtained.

A system of pipes, in excellent condition, has been discovered near Cologne, Germany. The pipes were installed by the Romans about the year A.D. 80 to supply water from the Eiffel Mountains to Colonia Agrippina—what is now the town of Cologne.

THE PORT PROPELLING UNIT OF THE C.P.R. LINER "EMPRESS OF JAPAN"

THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, LTD., GOVAN, ENGINEERS



The Canadian Pacific Liner "Empress of Japan."

No. II.*

As we recorded in our first article, the propelling machinery installation of the Canadian Pacific liner "Empress of Japan" has proved most efficient in operation, a figure of 0·552 lb. of oil fuel per S.H.P.-hour for propulsion only and 0·603 lb. for all purposes being obtained on the official trials. This result is outstanding in recent marine practice, and a detailed description of the turbines, boilers, and auxiliary machinery will therefore be of especial interest to our readers. The general design of plant is the logical outcome of the ideas which were initiated by Mr. J. Johnson, the owner's Chief Superintendent Engineer, and were first embodied in the re-engined "Empress of Australia," and further developed in the "Duchess" class of liners, with increasing economy in fuel. The characteristic feature of the "Empress of Japan's" propelling machinery, is the use of high pressure and highly superheated steam for the main turbines and also the boiler feed pumps and auxiliary turbo-generator sets, while for ships' heating, salt and fresh-water calorifiers, fuel tank heating, &c., low-pressure steam generated in two 200 lb. four-furnace cylindrical boilers is employed. These boilers are also used to pass steam to the main turbine sets, and so make up the feed-water loss in the water-tube boiler system. Practically all the auxiliary machinery other than that above referred to, is electrically driven, and current for that purpose is supplied by a combination of oil engine driven generator sets and steam turbine driven generator sets.

As the general arrangement drawings indicate, the engine-room is divided into two compartments, the main propelling machinery with its auxiliaries and the turbo-generators being placed in the after engine-room, and the Diesel generator sets with the feed-heating installation in the forward room.

The Main Propelling Machinery.

The main propelling machinery, which is shown in the drawings reproduced on page 207, consists of two sets of Parsons type turbines, constructed by the Fairfield Company, arranged to drive the propeller shafts through single-reduction gearing. Each set comprises one high-pressure, one intermediate-pressure, and one low-pressure turbine working in series, each turbine driving a separate pinion which engages with the main gear wheel. For astern running, a high-pressure unit is incorporated in the intermediate ahead casing and a low-pressure unit in the low-pressure ahead casing. Each of the high-pressure ahead turbines is of the impulse-reaction type, with a two-row velocity wheel having blades of rustless iron, while the reaction portion of the turbine is fitted with end-tightened blades of Monel metal. Nozzle control valves are provided in order to enable a very gradual increase of power to be obtained, and at the same time to maintain the pressure as high as possible in the control chest. Particular attention was paid to the lagging of all hot surfaces. The thickness of the plastic non-conducting material and mattresses for the high-pressure turbines is about 6in., in addition to which there are well arranged air spaces. It was considered essential for the well-being of the engineers, as well as from the point of view of thermal efficiency, that as little heat as possible should escape from hot surfaces into the atmosphere of the engine and boiler-rooms, and from our inspection of the machinery spaces it would appear that this desired end has been most successfully accomplished.

The intermediate-pressure turbines are of the reaction type with no impulse rings. The blading of the earlier stages is end-tightened, while that of the later stages is of the ordinary type, the material of the blades being phosphor bronze in all stages. The high-pressure astern turbine consists of a three-row impulse wheel and the low-pressure astern turbine of a two-row impulse wheel followed by reaction stages in which the blading is of rustless iron. Owing to the high temperature of the incoming steam, the casings for all the turbines were made of cast steel, except that of the low-pressure ahead turbine, which is made of cast iron. The low-pressure ahead turbines are of the double-flow balanced reaction type, with phosphor bronze blading. Each of the other turbines is fitted with a dummy to reduce the end thrust due to difference in steam pressure, and Michell thrust bearings of the spherical seated type are fitted to each rotor to take up any remaining axial thrust. In order to eliminate possible vibration, all the rotors were dynamically balanced, and during the trials, including the tests made in the shop at overspeed revolutions, no trace of vibration was experienced.

In order to facilitate the lifting of the turbine covers the receiver pipes are arranged underneath the turbines and connected to the lower halves in each case.

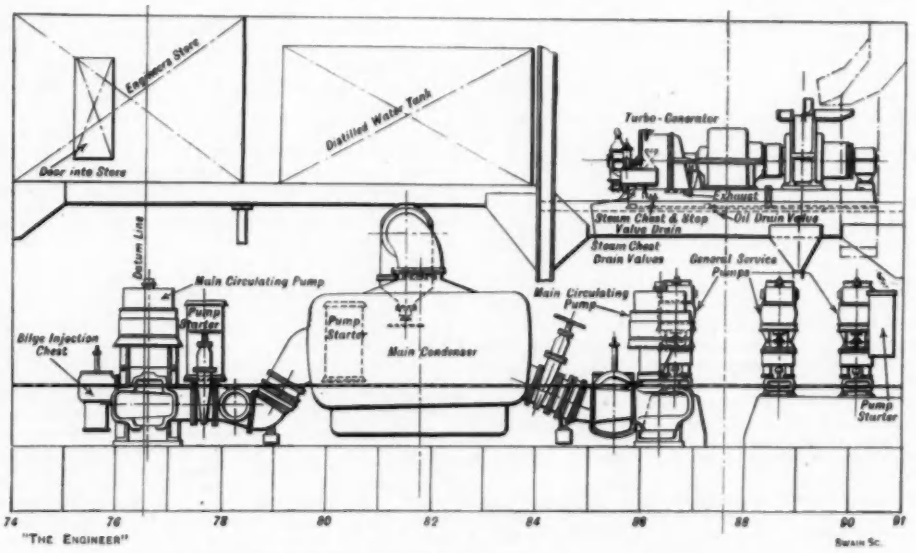
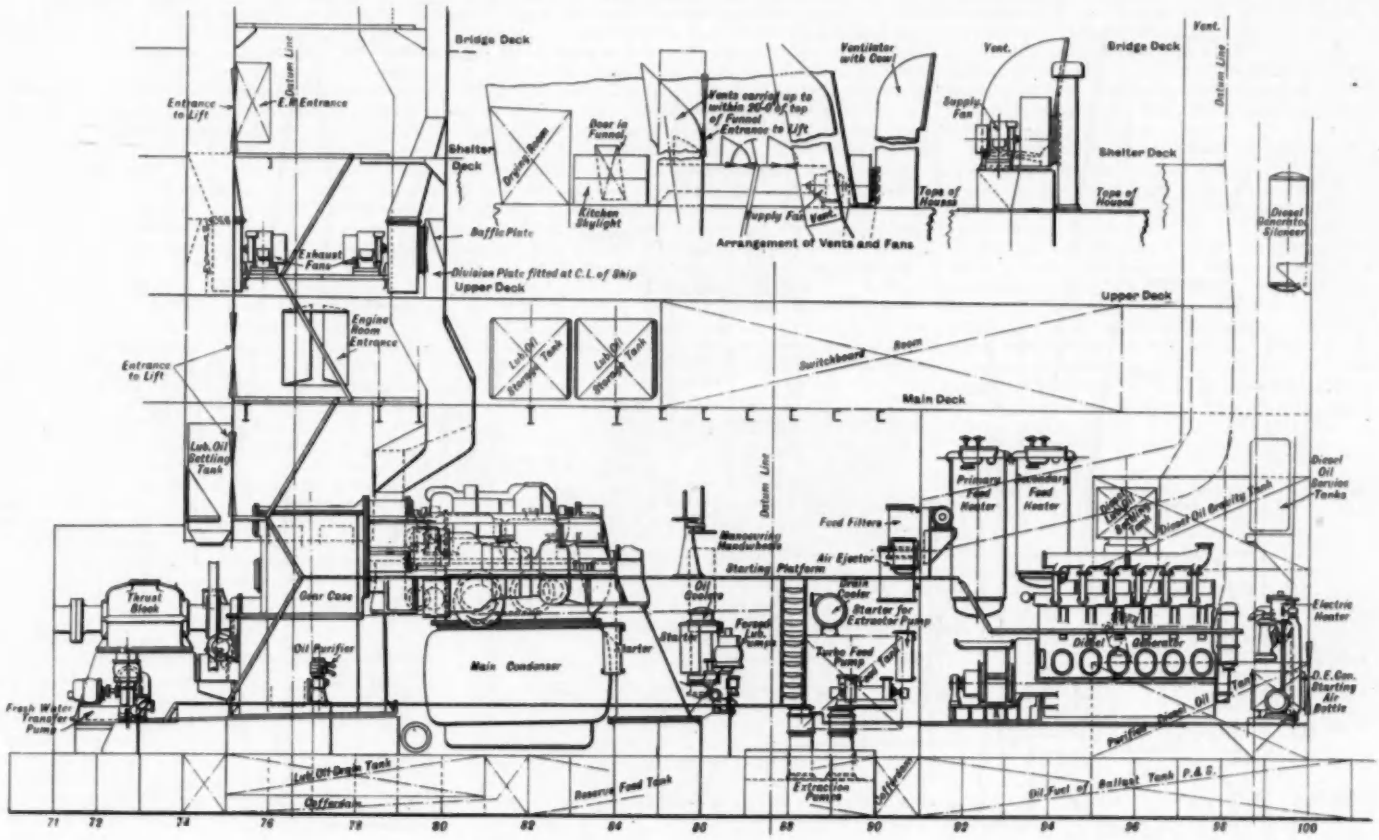


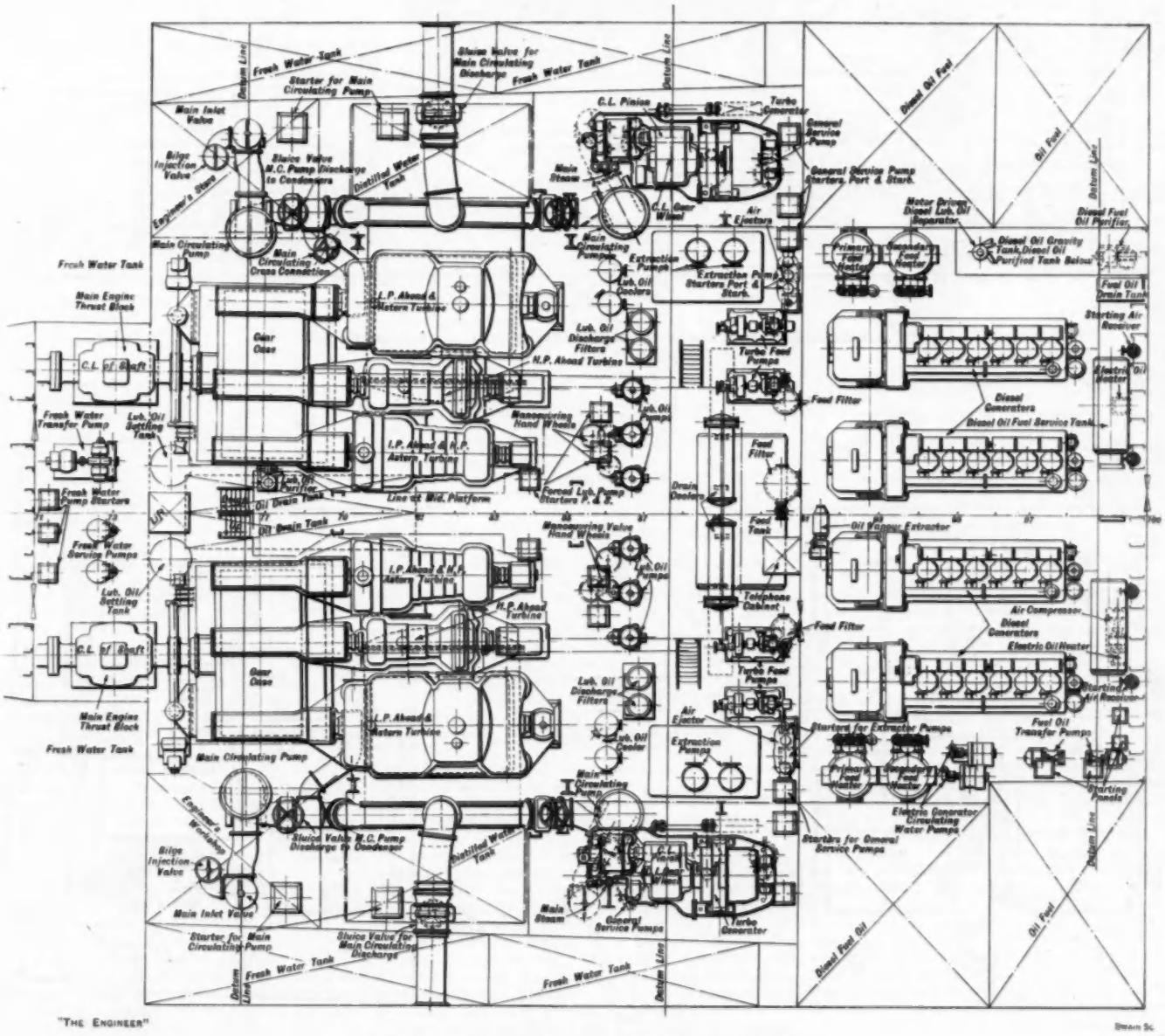
FIG. 6—CONDENSER AND CIRCULATING PUMP CONNECTIONS

* No. I. appeared August 15th.

"EMPRESS OF JAPAN"—ARRANGEMENT OF PROPELLING MACHINERY AND AUXILIARIES

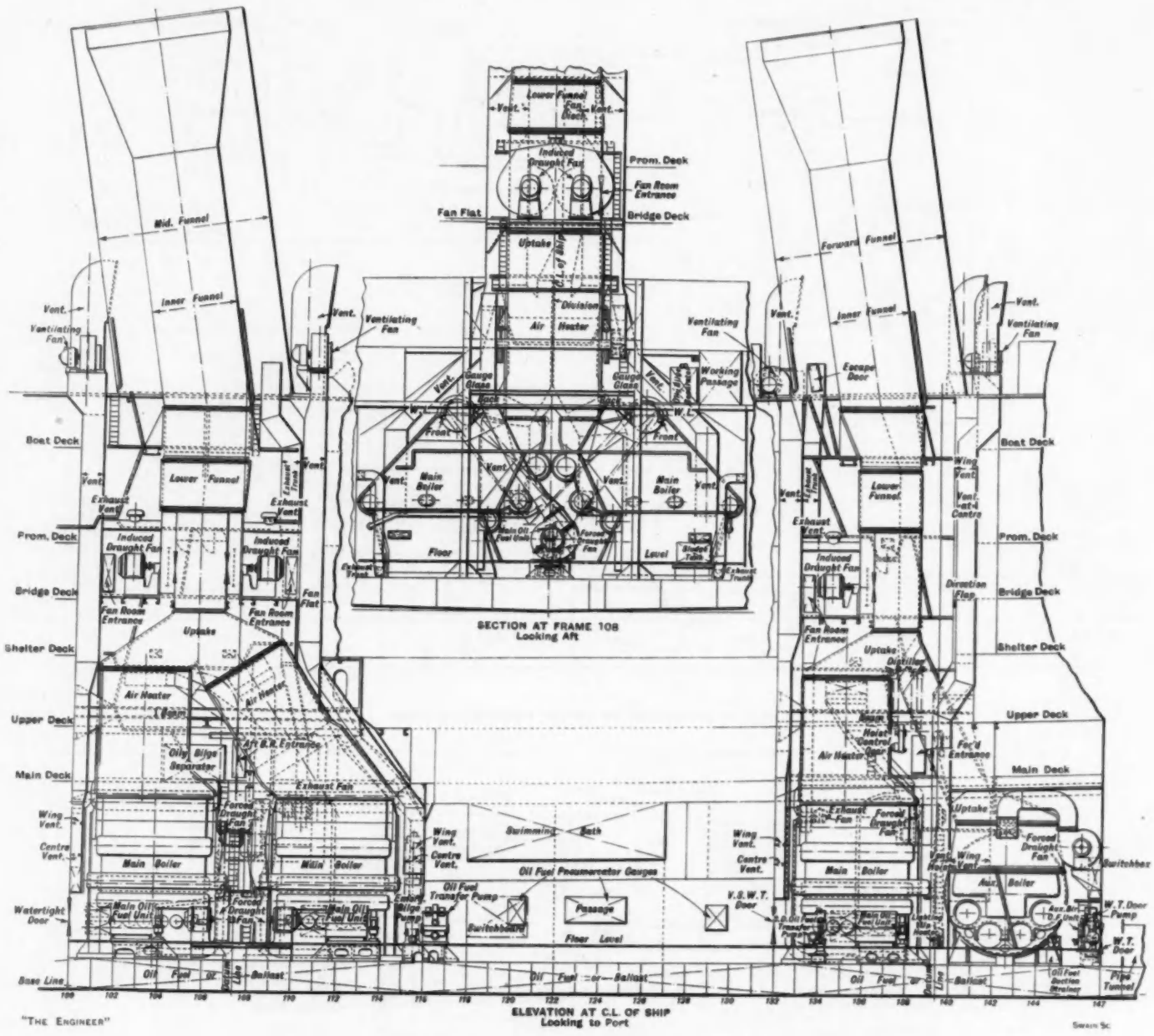


ELEVATION OF ENGINE ROOM LOOKING TO PORT

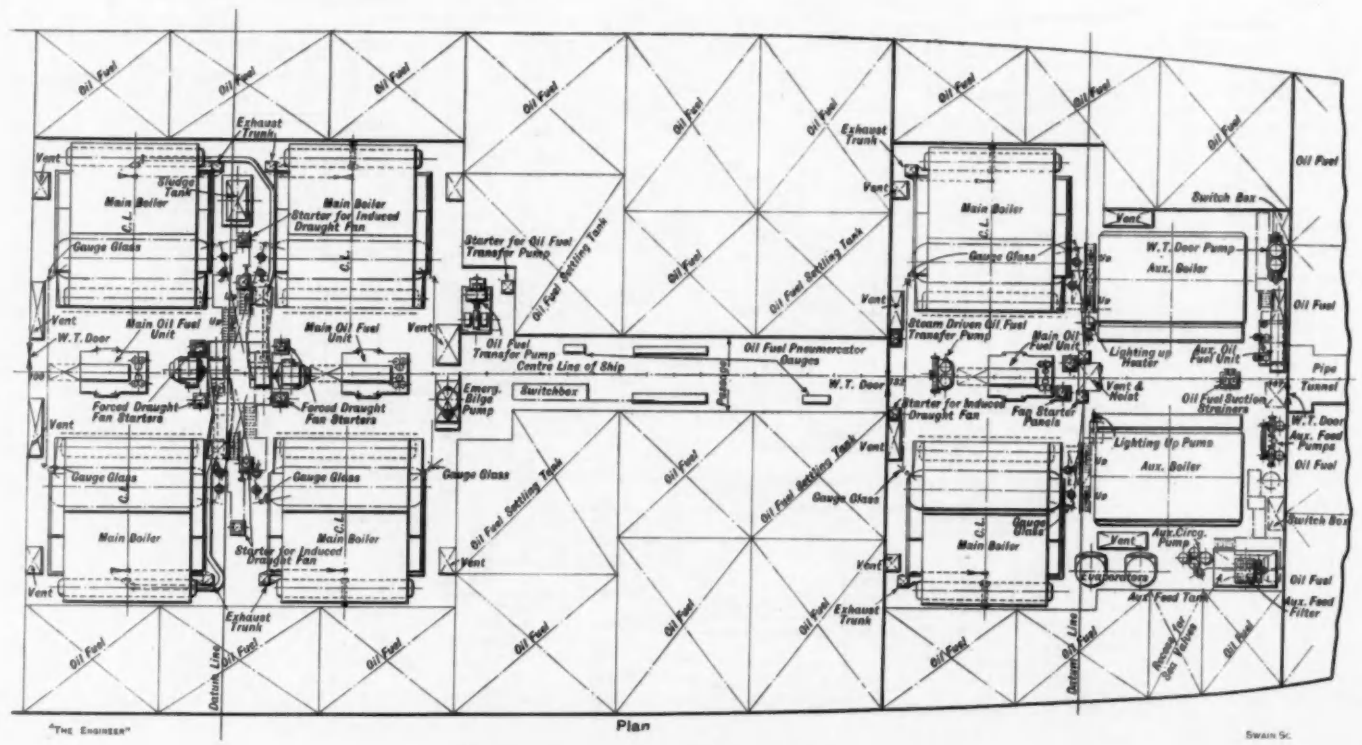


PLAN OF MAIN ENGINE AND GENERATOR ROOMS

THE "EMPRESS OF JAPAN"—BOILER INSTALLATION



LONGITUDINAL AND CROSS SECTIONAL ELEVATIONS OF BOILER ROOMS



LAY-OUT OF MAIN AND AUXILIARY BOILERS

Emergency connections are also provided so that an H.P. or an I.P. turbine can be cut out if at any time it should be found necessary to do so.

The turbines are supported at the forward end by massive cast iron stools in a similar manner to the arrangement of the turbines adopted in the first instance in the "Empress of Australia" and subsequently in the "Empress of Canada," while the after ends of the turbines are supported from the gear case in the usual manner. The method of support is clearly indicated in half-tone engraving on page 206.

The main gearing is of the ordinary double-helical single-reduction type, having a wheel of 162in. diameter, with a width of 59in. All the pinions are 13in. diameter, and they are connected to their respective rotors by flexible couplings of the claw type. Teeth of $^{7}/_{12}$in. pitch, and an helical angle of about 30 deg. are used.

The gear case—see page 206—is a massive cast iron structure, the lower portion being extended as a flat base to about 2ft. 6in. above the tank top. All seatings, both for the gear case and for the cast iron stools supporting the turbines are of plate and angle construction, and are incorporated with the structure of the vessel. As they are of large area, with a uniform and relatively low height, they are very strong and should avoid the troubles often experienced with high built up seats, the riveted joints of which are liable to cause lack of alignment with the straining of the ship in a seaway.

The condensers, it will be seen, are slung underneath the low-pressure turbines. They are of the Weir regenerative type, with a large reservoir at the bottom for storing the water required in connection with the successful operation of the closed feed system. Each condenser has 16,000 square feet of surface, with cupro-nickel tubes $\frac{3}{4}$in. diameter by 13ft. 6in. long. In order to ensure that the feed water for the high-pressure water-tube boilers is absolutely pure and free from contamination by salt, provision has been made for frequent tests on the steam side of the condensers. The water boxes have been carefully designed to facilitate a quick examination of the tubes, and large hinged doors have been fitted in each end. These are jointed with a rubber ring recessed into the casing, and are secured by swivel bolts and dogs. The construction is indicated on page 206. The time taken to release the dogs and open the doors for the examination of practically the whole of the tubes is only a few minutes. Two large storage tanks for distilled water are fitted in the engine-room wings, from which, when tests are being conducted, the condensers may be filled by gravity.

The thrust of the propeller is transmitted to the hull by Michell thrust bearings provided on the main lines of shafting immediately aft of the gearing, and the tunnel shafting is supported by bearings of the new Michell journal type, the width of which is only about one-third that of a plain journal. The propellers which were referred to in our last article, are of solid bronze, and were cast by J. Stone and Co., Ltd. They are 20ft. in diameter.

In the following table are summarised the principal particulars of the propelling and auxiliary machinery:

Main Propelling Machinery Particulars.

Type, twin-screw single-reduction geared turbines	
Designed service output	30,000 S.H.P.
Designed service speed	21 knots
Maximum output over long periods	33,000 S.H.P.
Designed astern output	65 per cent. of ahead
Turbine speed in normal service	1490 r.p.m.
Propeller speed in normal service	120 r.p.m.
Ratio of reduction	About 12·5 : 1

Boiler Installation.

Number of high-pressure water-tube boilers	Six
Designed working pressure	425 lb. per sq. in.
Total steam temperature	725 deg. Fah.
Number of low-pressure cylindrical boilers	Two
Designed working pressure	200 lb. per sq. in.

Auxiliary Generator Sets.

Number of oil-electric generator sets	Four
Designed output, each set	300 kW
Number of turbo-electric generator sets	Two
Designed output, each set	600 kW

THE BOILER INSTALLATION.

The boiler installation—see page 208—was constructed by the Fairfield Company to designs supplied by Yarrow and Co., Ltd., and is a development of the type of boiler fitted in the "Duchess" class vessels. It is of larger capacity and the working pressure and superheat are also higher. For the main propelling machinery, turbo-driven generators and the main feed pumps, steam is generated in six water-tube boilers of the Yarrow type, at a working pressure of 425 lb. per square inch and superheated to 725 deg. Fah. As will be seen from the drawings on the opposite page, four of the boilers are placed in the aft boiler-room and two in the forward boiler-room, along with the two cylindrical boilers which supply steam for make-up feed, ship's heating, and other auxiliary purposes.

Each of the main boilers—one of which is shown in Fig. 7—has one steam drum, three water drums, and one superheater drum, each drum being forged solid without either circumferential or longitudinal seam or joint, thus dispensing with riveted joints. As will be seen from the illustrations on page 208, the flow of the gases is through one side of the boiler, after which it passes through an air pre-heater and thence to the funnel.

The air pre-heaters are of the tubular type, and of very large surface. Comparing the practice of ten years ago, it is interesting to note that the large boiler heating surface which was then considered essential to economy has now been considerably reduced, while the air pre-heating surface, then comparatively insignificant, has now been increased so that the air heating surface now employed is about 25 per cent. more than the generating surface. Air trunks from the preheaters enclose the boiler casings to a large extent, so that heat transmitted through the casings is caught by the air and returned to the furnace, while a careful arrangement of lagging outside the pre-heaters, the hot air passages and the boiler casings has reduced the radiation losses to a negligible quantity.

Special provision has been made for carrying the weight of the boilers, the main support being in the form of vertical columns at the fore and aft ends upholding the steam drum, the weight of the other

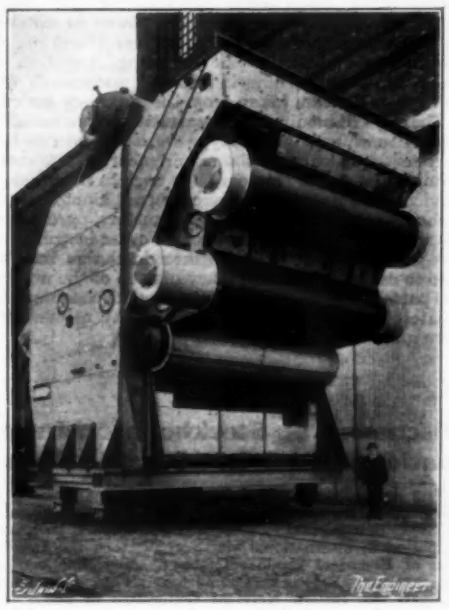


FIG. 7—ONE OF THE MAIN BOILERS

drums being carried by the tubes. Very little weight is therefore imposed on the fore and aft casings.

The saturated steam is taken from the main drum through a "Vortex" separator to one end of the superheater drum through an external pipe, and is directed by means of internal troughs and baffles, arranged in series through banks of the superheater tubes to the other end of the superheater drum. A high-lift safety valve, together with the main boiler stop valve, which is of the latest self-closing type, are fitted at the outlet end of the superheater drum. The boilers are fitted with automatic feed regulators on both main and auxiliary feed pipe lines, and soot blowers are provided at various stations in order to maintain the steam generating and superheater surfaces in a clean and efficient condition.

In addition to the usual boiler mountings, a low-water alarm and oil fuel control gear has been fitted to each boiler, which, when the water in the steam drum falls below a certain predetermined level, blows an alarm whistle, and shuts off the supply of oil fuel to the boiler. The apparatus—see Fig. 8—is manufactured by A. G. Mumford and Co., Ltd. It consists essentially of a submerged float arranged well below the water line in the steam drum. When the water in the drum falls in level a determined amount, the float operates, and opens a needle valve, which admits steam to the alarm whistle, and also shuts off the supply of oil fuel to the furnaces, thereby putting out all fires on that particular boiler. The design of the trip gear is such that the whistle continues to blow, and the fuel supply valve cannot be reset to pass oil until the level of water in the boiler drum has been reinstated. We were present at a test of this apparatus, and the whistle sounded and continued to sound four to five seconds after the water had disappeared from the gauge glass in the steam drum.

It may be noted that the firing space, instead of being athwartship in the usual way, is arranged fore and aft, thus ensuring efficient control, with free observation, from end to end of the boiler-rooms. The space between the boilers is, as shown on page 208, occupied by the Wallsend-Howden oil fuel units. We understand that a boiler efficiency of 87 per cent. will be comfortably maintained in service.

The auxiliary boilers for domestic and other auxiliary purposes are of the cylindrical return-tube type, and arranged to burn oil fuel with the Howden system of forced draught. They are designed for a working pressure of 200 lb. per square inch.

The supply of air for the main boilers is drawn from the boiler-room by six motor-driven forced draught Howden fans, one fan being provided for each boiler. In order to assist the draught under certain conditions, there are also six induced draught fans fitted in the uptakes above the air heaters, but arrangements are made which enable these to be by-passed if not required. For the auxiliary boilers one double inlet fan is provided, which can be connected to either of two motors, each with a separate starter, so that immunity from complete breakdown is thus provided; the fan arrangements are indicated in the drawings on page 208.

The main oil fuel installation consists of six units, each comprising one pump and one heater, with the necessary suction and discharge strainers. A duplex-type unit is provided for the auxiliary boilers and a motor-driven lighting-up set is fitted with connections to each boiler-room. For transferring oil to the settling tanks and between the other fuel oil tanks, one motor and one steam-driven transfer pump are installed. The feed pumps for the auxiliary boilers, together with an auxiliary condenser and circulating pump are installed in the forward boiler-room, and, in addition, there are two evaporators and two distillers, all adjacent to the cylindrical boilers, so that the auxiliary plant is very compact and convenient.

STEAM AND FEED CONNECTIONS.

The steam from each pair of water-tube boilers is collected and led to the bulkhead valves in a separate pipe, there being three main leads, and the bulkhead valves are isolated by two cross-connection valves, so that twin groups of boilers can be isolated. Both sets of ahead and astern manœuvring valves are combined in one chest, together with an additional master astern shut-off valve. Before entering the turbines, the steam passes through a wire grid strainer, which has been designed to reduce loss in

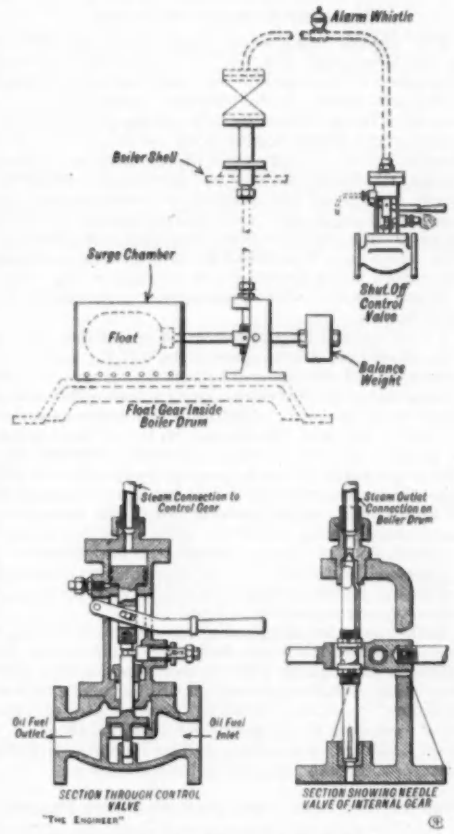


FIG. 8—LOW WATER ALARM GEAR

pressure to a minimum. The expansion of the steam pipes, owing to the high temperature of the steam, is taken up by Aiton corrugated pipe bends, the arrangement being very simple and effective.

The feed-water circuit for the main boilers is arranged on the Weir "closed feed" system, with a view to keeping the water entering the boilers as free from air as possible. The condensate in the well at the bottom of the condensers is withdrawn by motor-driven centrifugal extraction pumps, of which there are four, each designed to deal with 60 per cent. of the total condensate, and it is discharged through drain coolers to the feed pumps. There are four feed pumps of the Weir turbo-driven centrifugal type, two main and two auxiliary, using superheated steam from the main boilers. A large feed tank is placed at the forward bulkhead as a reservoir, and float-operated supplementary and overflow valves are fitted in order to maintain a constant level in the condensers. The water, on leaving the feed pumps, passes first through filters and then through primary and secondary heaters in series to the boilers. The primary heaters are supplied with auxiliary exhaust from the feed pumps and steam bled from the intermediate-pressure turbines, and the secondary heaters with steam bled from the high-pressure turbines. The drain from the secondary heater, together with the

feed regulator leak-off is led to the steam side of the primary heater, the drain from which yields up its heat to the feed water in the drain cooler, so that there is practically no loss. The air ejectors have three steam jets in series, and are supplied with steam from the auxiliary boilers and drain to the main condenser and feed tank, the additional water thus obtained going to make up for any loss which may occur in the main system. An electric salinometer is installed for testing the feed water for the presence of salt.

There are four main circulating pumps of the Drysdale vertical-spindle centrifugal type, driven by electric motors, and in Fig. 6 we show the arrangement of the pumps and the suction and discharge connections.

The forced lubrication systems of the port and starboard sets of machinery are quite independent. The oil is drawn from a drain tank under each set of gearing through duplex strainers and discharged to duplex filters to the oil coolers, and thence to the bearings to regulate the flow of oil as required. There are three motor-driven "Centrex" pumps on each side of the vessel and under normal working conditions two pumps on each side are in use. Should the oil pressure fall below a predetermined amount, or should the rotors move aft owing to wear in the thrust bearings, the bulkhead steam valves are automatically closed. A governor is fitted to one turbine in each set, which also operates the oil control gear on the bulkhead steam valves, if the revolutions should become excessive.

For the various duties of bilge pumping ballast, sanitary, wash-deck and fire service, a battery of six motor-driven pumps of the "Centrex" type are installed, all of identical design and with interchangeable duties. Two smaller pumps of a similar type are provided for the fresh water service.

Electric Generating Plant.

The electric generating plant was supplied by W. H. Allen, Sons and Co., Ltd. It consists of four oil engine driven generator sets, each having an output of 300 kW, placed in the forward compartment each generator being driven by a six-cylinder four-stroke single-acting Diesel engine with air injection. The installation is complete with independent circulating pumps, oil purifiers for fuel and lubricating oil, motor-driven emergency and starting air compressors, fuel transfer pumps and electrically-operated oil-fuel heaters. In addition to the oil engine driven generator sets, there are two 600-kW steam turbine-driven generators, which are placed in the main engine-room, and are supplied with superheated steam from the main boilers.

Under normal circumstances at sea, three of the four oil engine driven generators will be used, and these sets will also be used in port on account of their greater economy, thereby enabling the complete steam plant to be laid off. Owing to the space occupied, the first cost and the weight, it is not economical to provide reserve oil engine driven generator sets. The combination of steam and oil engine driven sets generators gives not only the advantage of two sources of supply, but also by making use of the steam sets when manœuvring with the main engines, a more constant flow of steam through the superheaters is maintained, and overheating of the elements prevented.

The oil engine generator-room is well ventilated, and a vapour extractor is fitted.

Store rooms are arranged at the aft end of the main engine-room at the lower deck level and between the shafts in the tunnel, while a workshop on the starboard side, containing a lathe, a drilling machine, and an emery wheel, is provided. There is also an electrical workshop on the main deck in which there are a small lathe and a sensitive drilling machine, suitable bench space being provided in both workshops.

Ventilating and Fire Extinguishing Plants.

As the "Empress of Japan" is primarily intended for the Pacific service through the Tropics, particular attention was paid to the ventilation of the machinery spaces, and the arrangements have proved in service to be very efficient. In each boiler-room there are four large trunks led to the stokehold from cowls situated round the funnel on the top of the casing; these are indicated in the upper view on page 208. The natural draught is assisted by two motor-driven fans on deck which discharge air through ducts leading into the natural draught trunks. The forced draught fans are placed low down in the stokehold and are arranged at the wings and at the centre so as to ensure a flow of air which efficiently ventilates both boiler-rooms. Two additional fans are also fitted in each room for drawing hot air from the spaces underneath the main boilers and from other pockets which would not be cleared in the ordinary way. A positive system of air supply is arranged in the engine-room, the air entering through large openings at the forward end of the engine-room as well as aft from the tunnel, and exhausting up the main hatch through the dummy funnel.

On the top of the casing above the generator-room there are two large supply fans discharging through trunks to this compartment, the trunks being split up into two, one half being led aft through the screen bulkhead into the lower part of the main engine-room, and the remainder of the air, after ventilating the auxiliary generator-room, also passing through an opening in the bulkhead into the main engine-room. Two fans, situated on the top deck discharging into trunks, are provided. They can be used either for natural or forced ventilation to the aft end of the engine-room from the shaft tunnel. Two supply fans are also fitted with trunks led to the wings of the engine-room. The outlet from the main engine-room is through the dummy funnel, the height of which induces a natural draught, and in order to assist this natural upcast, four exhaust fans are fitted in the main engine hatch drawing from the level of the upper deck and discharging to about the top of the dummy funnel.

A complete CO_2 system is fitted in both the boiler and the oil-engine rooms, consisting of high-pressure bottles situated in a house on the boat deck, with pipes led to a control cabinet on the main deck, accessible from the working passage. Should a fire occur in either boiler-room, the pulling of a wire is all that is required to flood the boiler-room with CO_2 gas. A few of the bottles are connected to a control placed in each stokehold with pipes led to a hose for dealing with small local outbreaks. A connection to the main CO_2 supply is also made from the fire-extinguishing installation supplied for the cargo holds, and hand extinguishers are placed in suitable positions throughout the boiler, generator, and engine rooms. In addition to the foregoing, a system of steam fire extinguishing is installed underneath the boilers, with steam taken from the auxiliary boilers.

The efficient manipulation and control of an installation of machinery of the type we have described is very far removed from the requirements of the more primitive methods employed for engines in ordinary service. We noted that torsionmeters, kinetometers, tachometers, long-distance thermometers, pyrometers CO_2 recorders, pneumercators, and other instruments are provided so that the engineer in charge may be able to determine the efficiency of each of the numerous parts of the large installation, and thus secure the greatest economy of fuel and reliability of performance under service conditions.

Discussion at Stockholm on International Electrical Organisations.

The growing number of international organisations in the electrical field has given rise to some concern, especially in Great Britain, and in order to co-ordinate British participation in international electrical matters, the Institution of Electrical Engineers formed some time ago an International Relations Committee. That Committee, through the British National Committee of the International Electrotechnical Commission, invited the I.E.C. to provide an opportunity for the holding of an informal meeting during its technical sessions in Stockholm, to discuss this important question. It was felt that the I.E.C. meetings would provide a fitting opportunity, in view of the large number of electrical engineers from many countries who would be present, and in view of the fact that the I.E.C. was the accepted body in the international electrotechnical field to act generally in this way.

The Committee of Action of the I.E.C., whilst taking no responsibility for any opinions which might be expressed at such a meeting, willingly agreed to the holding of an informal discussion during the technical sessions in Stockholm. The meeting was held in the Parliament House and was attended by a large number of the delegates—including engineers from twenty-two nations—who were present at the I.E.C. meetings.

The discussion was opened by Mr. P. Good, a member of the International Relations Committee of the Institution of Electrical Engineers, in a paper which he had prepared at the request of that Committee. Mr. Good, at the outset, emphasised the fact that, whilst the Committee had asked him to prepare the paper, it was actually an expression of his own personal opinion; the Committee did not feel that it could as a Committee make any specific proposals at this stage. In making a comparison between the I.E.C. and other international bodies, he showed that the I.E.C. existed for the specific purpose of obtaining agreement on standardisation questions, whereas the primary purpose of the other international bodies was the exchange of information and experience, and the bringing into personal contact of those engaged in similar work in different countries. Recent experiences, however, had shown that congresses of this kind had already reached the stage of being overburdened with papers which received very little attention, and some of which were not up to the standard of, nor appropriate for, international discussion.

Mr. Good pointed out the need for co-ordination in the international field, in order to avoid overlapping of effort, and he suggested in his paper the possibility of there being some changes in one or other of the existing organisations or the merging together of some of them into a body which should be representative of the electrotechnical industry as a whole throughout the world. Such a body would act internationally in the same way that the American Institute of Electrical Engineers and the Institution of Electrical Engineers in Great Britain do nationally, by the permanent affiliation of a number of electrical engineers in every country. It would thus have available the funds to promote continual international exchange of technical information, and the calling of conferences when necessary, such organisation being governed by representatives from properly formed national committees, each of which should be responsible for seeing that the papers contributed by members of its own country were of a standard which justified international consideration.

In the discussion which followed, Monsieur Brylinski (France) said that he did not feel that any overlapping was likely to occur in future, since satisfactory arrangements had now been made between the Paris High-tension Conference and the World Power Conference, which would, he hoped, take care of it in future. He therefore was not in favour of any change in the existing state of affairs. Monsieur Laspiere (France) said that the Council of the High-tension Conference had held a special meeting that morning to study the problem and was of the opinion that the idea expressed in the paper could have a certain amount of utility, although it felt that no decision could be taken at the moment, as the question was too important for it to come to a conclusion without going into it very deeply.

From the subsequent discussion it appeared that there was some slight confusion, some of the members thinking that the proposal was for the creation of a further international body, instead of the co-ordination of existing ones under one organisation. When that point was made clear, the majority of the delegates felt that there was quite a possibility in the suggestion which had been put forward, but that it would want very careful consideration before any definite action was taken. Mr. L. T. Robinson (United States of America) expressed the view that the proposals deserved very careful consideration. They appealed to him as being in the right direction.

Professor Lombardi (Italy) called attention to the proposal regarding the formation of a World Engineers' Federation, which had been discussed in Japan, and Mr. M. Semenza (Italy) urged full consideration of the proposal put forward by Mr. Good, as he felt that every endeavour should be made to prevent the creation of new organisations, and to bring about co-ordination amongst those which already existed. That, he felt, could not be done without some permanent central clearing house.

After other speakers had dealt with various points, the proposal put forward in the paper, *i.e.*, that the International Electrotechnical Commission should be asked to arrange a small representative meeting to discuss the subject of international organisations in the light of the discussion which had taken place, was unanimously adopted, this meeting to be held when the Comité d'Entente* was next called together.

Iron and Steel Industry for British Columbia.

According to reports published recently by the *Financial Post* (Toronto) and by the *Financial News of Western Canada* (Vancouver), the interests of the concern known as Coast Range Steel, Ltd., were two years ago taken over by a group of business men resident in Vancouver, B.C., and Detroit, Mich. During the past few months noteworthy progress is stated to have been made in the direction of definite plans for the establishment of a steel industry on the British Columbia coast at or near Vancouver. Investigations have been made for this group by the Freyn Engineering Company of Chicago, as the result of which arrangements are stated to be in progress for the provision of finance up to a total of 23,000,000 dollars, and the erection of a steel plant in the vicinity of Vancouver. The Coast Range Steel Company is also stated to be the owner of an extensive iron ore property on Texada Island, where there has been blocked out 6,924,000 tons of ore with an average iron content of more than 60 per cent. This ore is stated to be sufficient to keep the proposed mill in operation for more than thirty years, and the probability has been further established of the existence of an additional tonnage of ore within 1000ft. of deep ocean water. Deposits of limestone are stated to be available on the same island, and the Vancouver steel plant would be designed for an annual capacity of 300,000 tons of ore, producing pig iron and steel products 50 per cent. of which would be marketed in Western Canada, the remainder being produced for export.

Suitable coal for smelting purposes is available on Vancouver Island and elsewhere, and the high-grade limestone deposit is situated 5 miles from the ore to be used in the proposed smelter. It is hoped that financial arrangements will be completed within the next two or three months.

According to the detailed report of the Freyn Engineering Company, the proved ore of good grade from Texada Island amounts to 6,924,000 tons, with additional "probable" ore amounting to 5,000,000 tons. The average iron content from sixteen drill holes is 61·7 per cent., which is ten points higher in percentage than the average iron ores now being shipped to United States steel plants from Lake Superior and Lake Michigan mines. The ore is low in phosphorus, has a satisfactory manganese content, a low percentage of silica and alumina, and an entire absence of zinc, arsenic and titanium. Magnetite ore, says the report, presents no difficulties, and, when sintered, it is smelted in the blast-furnace with a lower coke consumption and a higher output than the Lake Superior hematite ores. The cost of ore mined and delivered at barge on Texada Island is estimated at 1·90 dollars per gross ton, reaching 3·69 dollars per ton when crushed and sintered at the blast-furnace. The deposit lies about 900ft. from the sea shore on Texada Island, where barges may be loaded for shipment to Vancouver, 50 miles to the east.

The engineers' report recommends preliminary sales of 1,000,000 tons of ore to Japanese interests, two concerns having, it is stated, shown definite interest in the annual purchase of 200,000 tons. Favourable climatic conditions enable the continuance of mining and shipping of the ore throughout the year, and the limestone deposits 5 miles from the ore are of high grade material containing 98 per cent. calcite, which can be cheaply quarried and shipped in barges to the manufacturing site.

The estimated cost of construction of the blast-furnace and coke oven plant is 7,400,000 dollars, or a total of 9,500,000 if inclusive of inventories, working capital, engineering, contingent expenses and interest during construction. The establishment of a plant with an initial production of 140,000 tons of pig iron is recommended, one half of the total to be sold and the remainder to be manufactured into steel. The market for pig iron would be in Canada and the Pacific Coast of the United States, and steel products would be marketed either in Canada or overseas. The initial plant, mine and quarry

* The Comité d'Entente was formed in Bellagio in 1927 for the better co-ordination of dates, &c., of international meetings, and to prevent as far as possible overlapping of effort.

cost is fixed at 15,490,000 dollars, in addition to 2,950,000 dollars for inventories and working capital, 1,560,000 dollars for engineering and contingent expenses, 829,400 dollars for interest during construction, and 2,170,000 dollars for financing and organisation expenses, making the total capital requirements 23,000,000 dollars.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

A Turn for the Better.

THERE was an improved attendance at the weekly meeting of the Midland iron trade in Birmingham to-day—Thursday—interest was decidedly more keen, and the general tone of the market was slightly brighter. Inquiries were in circulation with reference to material required to replenish depleted stocks at the works and in connection with the expected autumn trade. Great inroads have been made in manufacturers' stocks, and it only needs the slightest fillip to trade to ensure a corresponding movement in the direction of a real recovery in raw material purchases. There was evident to-day a tendency to break away from the rigid policy so long adopted of buying from hand to mouth, and while some consumers of pig iron increased the tonnage of their orders beyond recent levels, others negotiated for supplies sufficient to carry them over the next month or two. This is a move in the right direction, and given a slight improvement in demand for manufactured goods to sustain and increase the growing confidence, a gradual recovery of trade in the basic industries in this district should be within sight.

Improved Buying of Pig Iron.

By far the most satisfactory feature of the market this week has been the decided, though admittedly slight, improvement in purchases of Midland brands of pig iron. The tonnage being taken up is still much below the normal needs of the market, but it is considered a favourable omen that not only have specifications been heavier this week, but there has also been a movement on the part of ironfounders to enter into forward commitments. The movement is only in the initial stage, and such orders as are being placed do not cover more than about two months' requirements, but that certain of the foundries are departing from the hand-to-mouth buying in which they have so long persisted is a welcome sign of returning confidence. The reduction, recently, of 4s. per ton in Cleveland No. 3 iron has placed it on practically the same basis as Derbyshire material, and attention is this week turned to the possible displacement of trade which may result. Of late, Derbyshire smelters have been competing with some success in the Cleveland market, but it is doubtful whether they will now be able to secure orders from that source. It was stated on 'Change here to-day that the reduction announced by Cleveland makers was merely to give formal effect to a depreciation which had in reality taken place previously, and that, consequently, it is not anticipated there will be any considerable displacement of business as between Cleveland and Midland blast-furnacemen. Prices of Midland irons stand at £3 10s. for Northamptonshire No. 3 and £3 13s. 6d. for Derbyshire and North Staffordshire, delivered in the Black Country zones.

Blast-furnace Coke Dearer.

A firmer tone is noticeable in the market for furnace coke. Buyers are now unable to purchase on the favourable terms which prevailed in July. The price has improved to the extent of about 1s. 6d. per ton, and furnace coke now costs about 13s. 6d. at the ovens. The tendency of coke is expected to be slightly upward in the autumn, owing to the demand for fuel of various sorts for heating purposes.

Steel.

The steel works continue short of orders, and the market for this material is depressed. Nevertheless, the prices fixed by the Association for finished steel are firmly held. Angles are quoted £8 7s. 6d., joists £8 10s., and ship, bridge and tank plates £8 17s. 6d. Midland structural engineers report no improvement in prospect and complain of the keen competition for all constructional engineering contracts. Profits on the small business obtained are negligible, they assert. Black Country boiler works are moderately well engaged, and plates required by them command £9 10s. upwards. Staffordshire re-rollers are very short of work, for they cannot compete successfully with the foreigner. Competition from the Continent continues keen, and the progress of events on the Continent is still being anxiously watched by traders here. This week imported steel bars have reverted to £5 12s. 6d. upwards after the stiffening of the price at the beginning of the month. Steel tube strip has dropped considerably since the market was freed from control, and Birmingham merchants this week quoted £6 per ton delivered here, and in some cases a little less for German strip. Though the billet trade is supposed to be controlled on the Continent, prices are not, in fact, stabilised, merchants being ready to take £5 5s. to £5 8s. Sheet bars are on about the same level. In this district there is little confidence in the final success of the efforts to arrest the decline in foreign steel prices. Local makers quote £7 17s. 6d. upwards for small bars rolled from continental raw material and mild steel billets are named at £5 17s. 6d., though it is thought a lower figure would be accepted in the case of a substantial order. Staffordshire hoops are quoted £10 per ton at makers' works.

Staffordshire Bar Iron.

There is no change in the position in the finished iron trade in Staffordshire. Makers of marked bars are regularly employed, but makers of other grades have very few orders, and work is irregular. Unfortunately for the latter, the outlook is far from bright, and ironmasters are almost in a state of despair. In the common branch there is no chance of competing with importers of Belgian material, and it is doubtful even if a safeguarding order would materially assist home producers. The difference in price is enormous, far outweighing the dissimilarity in the quality of the respective materials. Foreign No. 3 iron is said by consumers to answer very well the purpose for which they require it; indeed, they assert they could not sell bolts and nuts made from native material in open competition. They can only afford to use Staffordshire raw material when all British material is stipulated in the order. Nut and bolt and fencing bars of local make cost £9 per ton, whereas Belgian No. 3 iron used for similar purposes costs but £5 12s. 6d. Crown bars are quoted £10 7s. 6d. per ton, but it is possible to place business at £10. Orders are few and far between. Marked bars are firm at £12 10s. per ton at makers' works. Orders for iron strip again show improvement, and producers uphold the recent selling figure of £11 2s. 6d. per ton delivered. Additional work would be very welcome just now, for order books are not in the same satisfactory condition they were some little while back.

Galvanised Sheets.

Business in galvanised sheets this week has been rather slack, both on home and export account, but local mills are able to continue regular rolling on the work at present on the books. A renewal of buying in the near future is, however, necessary, if production is not to be curtailed. Values are substantially unchanged, 24-gauge corrugateds being quoted £11 17s. 6d. Prices of lighter gauge sheets are as last week. Black sheets are in only poor request at recent rates, but an early expansion of demand in this department is anticipated.

Scrap.

Very few transactions have this week taken place in steel scrap, and it is impossible to determine the market value. Merchants generally adhere to recent quotations, but it is contended they would be prepared to consider offers at below quoted rates. Demand for practically all classes of steel scrap is uniformly dull, and Birmingham merchants do not profess to discern much prospect of an early improvement in the position.

Industrial Enterprise.

Despite the present depression in trade, considerable industrial development is in progress in the Black Country. It is evident that several well-known firms have confidence in the future, for they are preparing for a trade revival in no uncertain manner. The Goodyear Tyre and Rubber Company is extending its factory at Wolverhampton. The extension consists of a two-storey and basement building, measuring 80ft. by 140ft., adding 33,600 square feet to the factory, and will necessitate the employment of many additional workmen. Leyland Motors, Ltd., manufacturers of fire engines, &c., have recently acquired a large section of the former factory at Dudley of Bean Cars, Ltd., which, it is understood, is to be converted into a central repairing depôt and service station for the Midlands. Considerable structural alterations are to be carried out, and it is reported that repairing machinery and stock to the value of some £50,000 will ultimately be installed. Another industrial development is the acquisition by the British Electric Welding Machines, Ltd., of Castle Mill Works, Tipton, formerly belonging to the Earl of Dudley. The company, which, at present, is using only a portion of the works, is engaged in the production of electrical resistance, butt-spot and seam-welding machines, and also rivet and pipe-heating machines.

Locomotives for Brazil.

The Sentinel Waggon Works, Ltd., of Shrewsbury, is, I learn, to supply three 200 H.P. double-geared "Sentinel" shunting locomotives to the San Paulo Railway, Brazil.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Markets for Textile Machinery.

ALTHOUGH barely two-thirds the value of the shipments in July of last year, last month's exports of textile machinery represent a substantial improvement compared with the previous month. July exports amounted to 9221 tons, valued at £852,681—including 7662 tons of spinning and twisting machinery, valued at £668,886 and 1118 tons of weaving machinery, valued at £112,497—against a total of 8007 tons and £754,926 in June of this year and 14,109 tons and £1,296,485 in July, 1929. In spite of the boycott, British India continues to be the most important outlet for textile machinery exported from this country, the value of the takings during the period under review being £283,296. Russia was the second largest individual market with shipments valued at £87,546, followed by France with £78,517, China £77,009, the Netherlands £48,996, Germany £43,912, the United States £27,538, Japan £19,849, Australia £16,388, and South America £13,903, the aggregate shipments to "other European countries" being valued at £137,720. Exports during the January-July period of this year amounted to 59,403 tons, valued at £5,672,497, compared with 79,136 tons, valued at £7,170,932 in the corresponding seven months of 1929.

Manchester-Altrincham Line Electrification.

Notwithstanding the fact that operations have been interfered with by bad weather an early completion is expected of the electrification of the Manchester-Altrincham line, which has been undertaken by the London, Midland and Scottish and London and North-Eastern companies as joint owners of the Manchester South Junction and Altrincham Railway. The anticipation is that experimental trains will be running on sections of the line by about the end of next month and that the passenger service will be in operation by October or November. Lieut.-Colonel F. A. Cortez Leigh, chief electrical engineer of the L.M.S. Company, has had the supervision of the electrical work involved in the construction of the line, which will be operated at 1500 volts direct current with overhead wires. Power is being supplied by the Stretford Corporation.

Grain Elevators for the Argentine.

Arising out of a Buenos Aires cable message published during the past few days, which discussed a scheme for the erection of 800 grain elevators in the Argentine at a cost running into millions of pounds, a statement has been made here by a representative of the firm of Henry Simon, Ltd., flour mill engineers, Manchester, whose name was associated with it. The report is described in the first place as very much exaggerated and misleading, and it is explained that about eight months ago an arrangement was entered into by the firm with the Argentine Government that the former should prepare a report on the elevator problem in the Republic. That report has now been completed and presented for consideration. The point is stressed that, at the moment, the prospect of orders being received by Henry Simon, Ltd., is very indefinite and that there can be no question of such business coming to this country until the report has been carefully considered by Argentine Government officials.

Railway Matters.

The first of thirty new engines for service on the London, Midland and Scottish system left the works of Beyer, Peacock and Co., Ltd., Gorton, Manchester, last Friday. The bunkers are fitted with covers to protect the engine crew from coal dust when travelling bunker first. A substantial repeat order for mobile cranes capable of lifting 6 tons has been placed with Walker Brothers (Wigan), Ltd., Pagefield Ironworks, Wigan, by the L.M.S. Company. Following upon the reductions recently made in the *personnel* at the Crewe and Horwich locomotive works of the L.M.S. Company, further "cuts" are being made. At the Horwich works twelve engines have been ordered for 1931, but after next year it is understood that the works will be employed only for repair jobs and that no new engines will be constructed there.

Gas and Electricity Schemes.

The Unemployment Grants Committee has expressed its willingness to contribute towards the interest and sinking fund charges in connection with the scheme to reorganise the three gasworks of the Oldham Corporation at a cost of £204,000. A grant of £163,105 has been made to the Stalybridge, Hyde, Mossley, and Dukinfield tramways undertaking for cable laying.

Personal.

Mr. T. V. Blake, works superintendent at the Manchester Corporation's Bradford-road gasworks, has been appointed assistant gas engineer and manager at Blackpool. Mr. J. K. Swales, waterworks engineer and manager for Bolton Corporation, has been appointed to a similar position at Sheffield.

Obituary.

Mr. Christopher Booth, for over thirty years secretary of the Preston and District Engineering Employers' Association, died at Preston last Sunday.

Non-ferrous Metals.

Relatively little in the way of price movement has been witnessed on the non-ferrous metals market during the past week. The recent hopes of a steady recovery in the position of tin has not yet materialised, and although there has been no very pronounced weakness in this metal since last report, prices are the reverse of firm, and on balance, after a recovery from the lowest point touched, are about 15s. per ton lower on the week. Home stocks of tin are now at the formidable figure of nearly 25,000 tons, a fresh increase having been recorded, and it is obvious that until the output restriction measures are actually reflected in the supply position any real firming up of prices will be postponed. In the meantime the demand for the metal on English markets is of moderate extent. Heavy supplies of copper are having a weakening effect on values in this section, the past week's decline ranging from 10s. to 12s. 6d. per ton. The demand for all descriptions is anything but active, and refined as well as standard copper has eased off. Lead is firm, although not actually dearer on balance, and buying interest in the metal keeps up fairly well. Spelter is fractionally steadier, principally on restriction news, sales showing no appreciable improvement over recent levels.

Iron and Steel.

A somewhat more cheerful tone has pervaded the iron and steel markets here during the past week, although, apart from a slight increase in the tonnages involved in recent purchases of foundry iron, there has not been much improvement in conditions to justify hopeful views as to the future. Pig iron sellers have booked a little more business for near delivery dates, largely on the strength of the recent reductions in prices, without, however, any very extensive commitments forward. Derbyshire and Staffordshire brands of No. 3 iron for delivery equal to Manchester are quoted at 72s. per ton, with Cleveland at from 75s. to 76s., Scotch makes at about 94s., and West Coast hematite at 87s. Bar iron prices are maintained at £10 5s. per ton for Lancashire Crown quality material and about £8 15s. for seconds, but the demand in this section remains restricted. Fairly steady deliveries of boiler plates and other locomotive materials are reported on this market. In most other respects, however, particularly as regards constructional engineering, the demand for steel is quiet, with new orders few and far between and delivery specifications against contracts placed some time ago on a moderate scale. At the moment, quotations are steady at

about £9 15s. per ton for boiler plates, £8 17s. 6d. for tank plates, from £7 17s. 6d. to £8 for small re-rolled bars, £8 7s. 6d. for sections, £8 10s. for joists, and £9 7s. 6d. per ton for 3in. and upward bars. Current sales of imported steel, both finished and semi-finished products, are quiet.

BARROW-IN-FURNESS.

Hematite.

There is not a bright spot in the hematite pig iron market, and with steel departments idle stocks are increasing at a rate which will make restriction a necessity. There is a certain amount of business, it is true, but the total tonnage is not equal to the production. The reduction of prices on the East Coast has not improved the state of the market either. As to placing orders for forward delivery, there is either hesitation or indifference at present. Continental business is not what it was, and there has been a falling off of shipments. American business is not very noticeable at the moment, but with big stocks in the district trade may develop in this direction. Iron ore is not bright and the outlook is not very promising. This remark applies both to native and foreign sorts. The steel market is dull. The rail departments at Barrow are idle, but Workington may start shortly.

Shipbuilding.

On Tuesday, August 26th, Vickers-Armstrongs will launch from their Barrow yard a vessel, the "Otaio," for the New Zealand service.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Depression.

No improvement in the state of the steel industry in the Sheffield district can be recorded this week. Indeed, trade has not yet recovered the position it occupied before the August break, and it is well known that even that was far from satisfactory. In describing the conditions faithfully, one is open to be charged with undue pessimism, so that it is well, in the first place, to emphasise any bright features which may be discovered. It is true that some of works are fully occupied, but they are not concerned with the heavy lines. Manufacturers of special steels of high grade are in the best position, and they are doing a fairly satisfactory amount of business. Firms which meet the special requirements of British engineering, in the way of tool steel, steel parts and tools, are also doing fairly well, and orders received in Sheffield from the shipbuilding industry have also increased recently. But producers of open-hearth steel are very short of work. At the Templeborough and Rotherham plants of the United Steel Companies, only six out of more than twenty open-hearth furnaces have been operating. The number of unemployed in Sheffield has now reached 43,000. Conditions are also very bad in North Lincolnshire.

Raw Materials and Scrap.

There has been a further reduction in the price of foundry pig and in tungsten prices, but the concessions have not stimulated trade as was hoped. Forward buying of foundry and forge iron is almost non-existent, nor does consumption at the foundries tend to improve. The market for steel scrap always presents a true reflection of the state of the steel industry, and it is therefore significant that this market has suffered further reaction. Values are being adversely affected by increasing imports of scrap, while exports, which were very heavy last year, have declined almost to the vanishing point.

Steel Trade Statistics.

The National Federation of Iron and Steel Manufacturers has stated that the number of furnaces in blast at the end of July was 105, a net decrease of 26 since the beginning of the month. The output of steel ingots and castings during the month amounted to 621,400 tons, compared with 600,100 tons in June, when production was affected by the Whitsuntide holidays, and 804,800 tons in July last year. In the Sheffield district the production of steel during May amounted to 65,200 tons, compared with 85,400 tons in May, and 86,200 tons in June last year. The figures for Lincolnshire are 61,500 tons in June, compared with 57,400 tons in May and 63,200 tons in June last year. Export trade in iron and steel materials made a substantial recovery last month from the exceptionally low record of June, the increase exceeding 50,000 tons. The total, however, falls short of July last year by 70,000 tons, and the present month has started badly.

Government Contracts Secured.

Several Sheffield firms have secured work as a result of the latest issue of Government contracts. The War Office is getting gun billets from the English Steel Corporation, Ltd.; steel rods from S. Fox and Co., Ltd.; round steel from Hadfields, Ltd.; and stainless steel from T. Firth and Sons, Ltd. To the Crown Agents for the Colonies, railway tires are to be supplied by Brown Bayleys Steel Works, Ltd., and Craven's Railway Carriage and Wagon Company Ltd. Ivory-handled knives with stainless steel blades are to be supplied to the Admiralty by Harrison Brothers and Howson, Ltd., and Joseph Rodgers and Sons, Ltd.

New Pipe Foundry.

Considerable progress has been made with the work of constructing for the Staveley Coal and Iron Company a new foundry for the manufacture of cast iron pipes by a new spinning process. Although it is stated that it will not be ready for operation before next year, the steel skeleton of the building is beginning to take shape. The company's existing foundry is reported to be busily engaged, and it is stated that there is sufficient work on hand to last into 1931. All kinds of pipes, varying from huge examples for water mains or chemical works to very small kinds, are being made.

Mill Electrification.

A 27in. reversing mill of Brown Bayley's Steel Works, Ltd., Sheffield, is to be electrified, the English Electric Company, Ltd., having secured an order for the whole of the electrical plant required for the change over from steam power. The mill rolls alloy and high-carbon steel ingots, 23 cwt. in weight, down to billets and small sections. It is to be directly driven by a single direct-current motor having a maximum output of 6000 B.H.P., the machine being also designed so that at a later date this output may be increased to 12,000 B.H.P. by the addition of further generating plant. The equipment will include a converting set, consisting of an 11,000-volt, 2000 H.P. motor driving a large direct-current generator, interposed between the supply mains and the mill motor. To smooth out excessive peak loads, the converting set will be provided with a cast steel high-speed fly-wheel, weighing 21 tons, and having a rim speed of approximately 240 miles per hour.

Sheffield Steel for Destroyer.

High-pressure steam machinery is being introduced into the destroyer "Acheron," now being built for the Admiralty, and John Brown and Co., Ltd., of Sheffield, have been concerned in the manufacture of the forged steel drums required. Each boiler is designed for a working pressure of 500 lb., with a superheat of about 280 deg. Fah., and is to be equipped with air preheaters.

New Uses for Steel.

As mentioned last week, negotiations are proceeding between the British Steel Works Association and the Iron and Steel Trades' Confederation with a view to devising a scheme by which greater use may be made of British steel. Mr. Walter Dodgson, of Sheffield, divisional secretary of the Confederation, has made several suggestions. He contends that stainless steel should be used to a far greater extent in local housing schemes, and emphasises its decorative, durable and labour-saving qualities. He also asks the Sheffield Corporation to provide cheaper electric power for steel works during the night shift. Experiments have been made in Sheffield with the use of steel dust-bins and efforts are being made to increase their use throughout the country, with a view of finding a new outlet for the use of Sheffield steel. The importance of this move can be realised when it is stated that the 130,000 bins required by Sheffield alone would mean a steel consumption of 2165 tons.

Railway Trade Prospects.

Few branches of the steel trade have suffered so severely from depression recently as that concerned in meeting the requirements of the railways. The British companies have been placing orders only on a hand-to-mouth basis, and they have recently been effecting further economies, so that the prospects of Sheffield firms securing more railway work are far from bright. Consequently, it is interesting to note that a delegation from the L.M.S. Railway Company is in the United States studying American methods of steel construction of rolling stock. If it is decided to undertake extensive replacement of wood by steel, the effect on Sheffield trade will be enormous. Mr. A. J. C. Walters, secretary of the Sheffield Chamber of Commerce, points out that a number of steel coaches have been in use on the home railways for some time past, and that one Sheffield firm received orders for steel to be used in the construction of all-steel carriages quite recently. The steel required was of a quality capable of being produced by most Sheffield firms, but the orders placed up to the present have been comparatively small. It is hoped that means will be found to overcome the drawbacks of steel coaches, which are that they are hot in summer, cold in winter, and rather noisy.

South American Trade Mission.

The members of the Sheffield Industrial Mission to South America are now at Rio de Janeiro. They include the Master Cutler (Mr. A. K. Wilson), Mr. C. R. Hodgson (President of the Sheffield Junior Chamber of Commerce), Mr. Laurence Halpin, Mr. Gerald Balfour, and Mr. W. Harrison, and they are to visit Brazil, Uruguay, the Argentine, Chile, and Peru, in the interests of Sheffield industries, following up the recent trip of Lord D'Abernon's Commission to South America.

Bridge and Road Schemes.

Difficulties have arisen in connection with the £1,750,000 Humber Bridge project. The Government has agreed to provide 75 per cent. of the cost, providing that all the public authorities on the Yorkshire and Lincolnshire sides of the river unite in contributing the balance, but the East Riding County Council, which had been expected to contribute £50,000, has announced its withdrawal from the scheme. The East Riding County Council has placed a contract with the Cleveland Bridge and Engineering Company, Ltd., for the construction of a bridge to replace the existing narrow bridge carrying the Howden and Hull road over the London and North-Eastern Railway at Gilberdyke. The new steel bridge at that point is to be 120ft. in length, the floor being of reinforced concrete, and 220 tons of steel work will be used. It will cost £27,596. Road and sewerage work to be undertaken by the Mansfield Town Council will cost nearly £60,000. The work of filling up the Queen's Dock, Hull, bought by the Hull Corporation from the railway company for £117,000, has begun. There are 10 acres of water space to fill in and the company has agreed to do 75 per cent. of the work.

Death of Former Master Cutler.

Mr. James Neill, of The Croft, Carsick, Sheffield, a former Master Cutler, and head of the firm of James Neill and Co., of Composite Steel Works, Sheffield, has died at the age of seventy-two years.

NORTH OF ENGLAND.

(From our own Correspondent.)

Order for Floating Dock.

In face of fierce competition, Swan, Hunter and Wigham Richardson, of Wallsend, have secured an order to construct a floating dock for the Wellington Harbour Board, New Zealand. The dock will take about a year to build, and in appearance will be a smaller edition of the Singapore dock, which was built by the same firm. It will be 540ft. long and 117ft. broad, with a lifting capacity of 17,000 tons. The Singapore dock is 855ft. long and 172ft. wide. The new dock will be used exclusively for merchant vessels, whereas the Singapore dock is for warships. The task of towing the new dock out to its destination, believed to be a record for distance, will take about five months. It will probably be towed in one section. A start on the actual construction of the dock will be made in September or early in October. By that time the vessels at present under construction will be completed, so that the firm will not be pushed for room. It will be more or less a rush job, as the firm has to have it ready for sea early next summer. The dock will provide plenty of work for the firm's men during the winter, and will also benefit contracting steel and engineering firms in the district. Naturally, the placing of this contract, following the large order placed with C. A. Parsons and Co. by the Newcastle Electric Supply Company for three turbo-alternators, has come as very welcome news to Tyneside. Both orders mean steady employment for a large number of men, although the general effect may not be felt for some months.

Cleveland Iron Trade.

Seasonal quietness is pronounced, and the annual trade holidays are holding up business this week, but a rather more hopeful view is taken of the near future. Autumn requirements may be heavier than was indicated a little while ago. Some opening out of inquiry has followed the substantial drop in Cleveland pig iron prices. Market values are now down to a level which customers are likely to pay, and the use of Midland iron on Teesside should be checked. Cleveland producers will continue to absorb the bulk of the limited output when their consuming works resume operations. They hope to extend their direct sales to home users who have to come on the market for supplies, but there seems little prospect of material expansion in the export trade. Several blast-furnaces are damped down this week owing to the holidays. Hitherto they have been kept in operation. No. 1 Cleveland foundry iron is 66s., No. 3 G.M.B. 63s. 6d., No. 4 foundry 62s. 6d., and No. 4 forge 62s.

Hematite Pig Iron.

East Coast hematite pig iron producers adhere to recent quotations, which are now more in normal proportion to values of Cleveland pig iron than they have been for a long time. Second-hands are still anxious to unload their rather considerable holdings, and are prepared to shade 71s. for ordinary qualities, but makers are not disposed to name below that figure, and ask a premium of 6d. per ton for No. 1 iron. Continental competition in markets abroad continues keen, but a few small sales for overseas are understood to have been put through.

Ironmaking Materials.

Sellers of foreign ore are unable to do new business of moment. Consumers have large stocks. The price of best Rubio ore is nominal at 19s. c.i.f. Tees. Prompt parcels of good medium blast-furnace coke of good average quality are still obtainable at 16s. 6d. delivered to works in this area, but sellers hold out for more for forward supply.

Manufactured Iron and Steel.

Producers of manufactured iron and steel are much in need of orders. There is ground for belief that specifications for shipbuilding requisites will be distributed a little more freely shortly, and structural steel producers expect to be busier, while tonnage output of railway material may be increased. Sheet producers have a fair amount of work on hand, but would welcome buying. Prices are unchanged.

The Coal Trade.

It is anticipated that the recent dullness in the Northern coal trade will end with this month, and that thereafter a steadily improving demand will set in. Winter stocking at all the principal centres is stated to have been on a very small scale, and with the approach of the shorter days operators will be more eager to cover requirements. During the past few days the tone in all qualities of Northumberland steam coal has eased down, and very few collieries are in a position to work full time. This is due to a large extent to holiday influences. Best steam coal can be covered easily at the fixed minimum of 13s. 6d., and second-class steam coal is plentiful at weakly held late prices, but through second-hands some slight discounts can be enforced. Tyne prime steams are working under restricted conditions, and the output is cleared at the fixed minimum of 12s. 9d., with smalls at 10s. Durham gas coal is fairly well booked up for two or three weeks ahead and owners have no difficulty in maintaining late values. Holmside or similar and the special Durham qualities are holding very steadily at 15s. for prompt, but producers ask 15s. to 15s. 3d. for next month's deliveries. Durham coking unscreened is quiet and stocks are on offer abundantly at an easy range of 12s. 6d. to 13s. Secondary gas coal and bunker qualities are difficult to clear at 12s. 6d. to 12s. 9d., but first-grade bunkers are in sustained demand and firm at 14s. In the coke trade makers are anticipating a substantial renewal of buying for September and onwards, and they are not forcing the market, preferring to mark time and hold steadily. Patent oven coke for spot shipment is available at 17s., but for next month the minimum price is 17s. 6d. Some makers hold for a minimum of 18s. Beehive and special grade of coke is in quiet demand, but commands a full 24s. to 28s., according to brand.

Admiralty Order.

The Admiralty has placed an order with the Central Marine Engine Works, West Hartlepool, for two sets of reciprocating engines and boilers for two small vessels required for the Navy.

SCOTLAND.

(From our own Correspondent.)

Markets Continue Dull.

THE past week has not brought any change in the steel, iron and coal markets, and proceedings generally have been dreary in the extreme. Some are of the opinion that a considerable volume of business will have to be placed in the near future, partly on account of new tonnage to be built on the Clyde, but meanwhile producers are very short of orders, and cannot keep going in the hope of contracts which, doubtless, if placed *en masse*, would mean a certain amount of activity, but when scattered over a number of months might be just sufficient to preserve a minimum amount of employment, in view of the lack of general business. Steel is very irregular, and some branches of the iron trade have shown little activity for months past, while the coal market still bemoans the lack of foreign business. Immediate advices do not promise an early improvement in any direction.

Steel.

Reports from steel makers still indicate a scarcity of new business in ship and boiler plates, and also sections. As a rule, producers can only see a few days ahead. Light steel sheets are fairly busy, but heavy black sheets and galvanised descriptions are poorly specified. Small tubes remain inactive. Prices generally are unchanged, and it is thought that buyers will perhaps operate more freely on the assumption that quotations are not likely to weaken meantime, owing to the continued high costs of production. In certain materials, of course, makers are up against keen foreign competition in the shape of lower prices and quick deliveries.

Iron.

For a long time past bar iron has been in the doldrums, and the position still lacks encouragement. The level of prices preserved is without inducement to buyers, and there seems little prospect of cheaper quotations for some time yet. Re-rolled steel bars, too, at £7 12*s.* 6*d.* per ton home and export, are more or less neglected. The output of pig iron is on very reduced lines, only eight furnaces being in blast at present, four having been damped down during the past week. Inquiries are meagre and quantities continue to arrive from abroad.

Scrap.

Scrap materials still show a tendency to weaken in price, cast iron machinery being now quoted 62*s.* 6*d.* and heavy steel 51*s.* 3*d.*

Coal.

The coal market is without much change. Export inquiries generally are few in number and industrial requirements are below normal. In round coal, Lanarkshire splints are the strongest feature, while ells and best Fifeshire steams are in a slightly better position. Nuts are firm. Aggregate shipments amounted to 237,519 tons, against 234,348 tons in the preceding week and 253,988 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

CONDITIONS in the steam coal trade are not good, but they are not without interest. Last week it looked as if shipments might be comparatively satisfactory, as the supply of tonnage at the commencement was better than usual; but, unfortunately, the second half of the week saw a marked falling off in tonnage, inasmuch as on Saturday there were forty-seven idle tipping appliances at the various docks. The returns of the Great Western Railway Company for the six leading ports showed that the shipments for the week came to 498,900 tons, which certainly was an improvement upon the previous week, when the total was only 315,100 tons; but when set against the quantity for the corresponding week of last year the total was anything but good, seeing that the quantity then was 656,459 tons. This shows that there is considerable room for expansion in business, and that there must be much slackness in the coalfield. It illustrates the quietness of operations and the difficulties of coalowners in carrying on when it is stated that notices have recently been served on close on 2500 workmen in the Western Valleys of Monmouthshire to terminate their contracts in a fortnight's time, so that unless there is a marked improvement in the situation in the meantime there is a probability of this number of men being added to the unemployed list. The outlook so far as the immediate future is concerned is not as promising as appeared to be the case recently, as although inquiries are coming forward for a few prompt cargoes, some of them are of small size and of a difficult description, and there is no definite indication of an appreciable expansion in operations, such as to make exporters really busy. In the case of Spain the conditions from the financial aspect are less satisfactory, as the peseta has touched a fresh low record since last week. On the other hand, apart from business which is being negotiated for supplies of coal for delivery over a period to the French railways, the report is current that one of the leading Brazilian railways is in the market for about 200,000 tons of steam coals for delivery up to the end of this year. As regards the tonnage question, one noticeable feature of the past week is the fact that, except for South American destinations, tonnage is not on offer anything like so freely as was the case a few weeks ago. Owners appear to be holding for higher rates before bringing out tonnage which is laid up. A number of steamers have gone to the River Plate to take advantage of the much improved rates which have been offered for homeward cargoes, while, on the other hand, rates outward from this Channel have fallen considerably, as may be gauged from the fact that tonnage has been fixed for Buenos Aires at 10*s.* 9*d.*, which is the lowest rate since December, 1909. A month ago the rate obtainable was 14*s.* to 15*s.*

Coal Trade Regulation.

South Wales coalowners met at Cardiff on Thursday last week for the purpose of considering the question of the amendment of the marketing scheme in order to make it conform with the conditions of the new Mines Act. As is well known, the Act (Part 1) makes it compulsory for the adoption of a scheme for the regulation of the production, supply and sale of coal by owners in all the scheduled districts. Each district scheme must provide for the classification of coals, the regulation of production within the limits of the district allocation to be periodically fixed by the Central Council, the fixing of minimum prices for all classes of coal, the collection of levies, &c. These schemes have to be submitted to the Secretary of Mines before September 12th. Whereas formerly there have been in this district a number of collieries outside the scheme which has been in operation, they will all have to come in when the new Mines Act is brought into force. There is to be a meeting of all coalowners in South Wales on September 1st, when a report will be submitted of the principles to be embodied in the South Wales scheme, and the meeting will be invited to appoint five representatives to serve on the Executive Committee of the Marketing Association to represent those owners who are not members of the Association.

Steel Hatch Covers.

Considerable interest has been aroused in shipping circles by the findings of the court of inquiry on behalf of the Board of Trade into the loss of the s.s. "Radyr," particularly the court's recommendation that the use of steel in the construction of hatch covers should be considered. On this point a leading ship surveyor has since stated that experiments had been tried with steel hatches years ago, and both on the score of cost and efficiency it was found that the present practice of timber hatches was the best, especially for short voyages, during which the hatches had to be moved frequently. It was pointed out that steel hatches must of necessity be much heavier than timber and could not be put on or removed so easily. They were more easily damaged and more difficult to secure in a water-tight manner. Exceptionally strong steel hatches could be made and might be of service for long voyages. Sliding hatches had been tried, but discarded. Without doubt the recommendations of the court would be considered by the Board of Trade and by shipowners, shipbuilders and others interested, and if any practicable change could be made it would be carried out.

Engineering Contracts.

Contracts placed recently by the Great Western Railway Company, including bridge widening at Cardiff and the erection of new coal hoists at Swansea, Barry and Port Talbot, make interesting reading for all who are concerned in the modernisation of appliances to keep abreast with trade requirements. At Swansea the London, Midland and Scottish Railway Company is installing an electrical belt conveyor at the Prince of Wales Dock possessing some new features. This conveyor, it is stated, will be capable of shipping coal at the rate of 700 tons per hour, or practically double that of the existing tip. Work is to be commenced almost immediately on its installation.

Ship Repairing.

Conditions in the ship repairing industry of this district are perhaps a shade better at the moment, but the improvement is nothing to call for special note. Reference was made a week ago to the loss of a fairly substantial contract to this district, the order for the repair of the s.s. "Pentreath" going North. Since then another fairly good order has been secured by T. Diamond and Co., Ltd., of Cardiff, in open competition, this being in respect to the Cardiff-owned steamer "Bryntawe," which sustained extensive damage in July last in the Norwegian Fjords when on passage from Archangel to Sharpness. The work will take about three weeks to execute, after which the steamer will proceed to the Kara Sea, having been fixed on time charter to the Russian Soviet Government.

Current Business.

The tone of the steam coal market continues to be very quiet, as new orders continue to come along slowly. Nominally prices have not undergone any change, supplies of large being excessive, though a few collieries are well stemmed for the remainder of this month and the early part of next. Smalls have made no advance, buyers being able to secure their requirements without difficulty. Sized coals remain steady. Patent fuel makers are not appreciably better off, while coke is quiet in demand. Pitwood is a shade weaker at about 27*s.* 6*d.* to 27*s.* 9*d.*

THE IRON AND STEEL INSTITUTE.

IN accordance with previous announcements, the autumn meeting of the Iron and Steel Institute will this year be held in Prague. The meeting will take place under the patronage of the Czechoslovak Government, and by the invitation of the Society of Czechoslovak Engineers, with the support and co-operation of the iron and steel industrialists of Czechoslovakia. The arrangements for the meeting have been carried out by an executive committee, the chairman of which is Dr. Vladislav Sykora, President of the Society of Czechoslovak Engineers, with Mr. J. Lubina as Hon. Secretary. The sessions will take place at the House of the Society of Czechoslovak Engineers, on Monday and Tuesday, September 15th and 16th. The subsequent arrangements include visits and excursions to the principal iron and steel manufacturing and engineering establishments in Czechoslovakia.

The following is the complete list of papers to be presented at the meeting :—

1. D. F. Campbell : "High-frequency Steel Furnaces."
2. W. H. Hatfield : "Permanence of Dimensions under Stress at Elevated Temperatures."
3. A. Kriz : "The Heterogeneity of an Ingot made by the Harmet Process."
4. A. Kriz and F. Poboril : "A Contribution on the Constitution of the Fe-C-Si System."
5. O. Quadrat : "A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram."
6. A. Regner : "The Magnetometric Determination of the Curie Points."
7. J. Sarek : "What Reasons Compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces ?"
8. L. W. Schuster : "The Effect of Contamination by Nitrogen on the Structure of Electric Welds."
9. F. Twyman and A. A. Fitch : "The Quantitative Analysis of Steels by Spectrum Analysis."
10. E. Walldow : "The Mechanism of the Solution of Cementite in Carbon Steel and the Influence of Heterogeneity."
11. H. C. Wood : "Open-hearth Furnace Steel Works : A Comparison of British and Continental Installation and Practice."

The following programme has also been arranged :—On Monday, September 15th, at 10 a.m., a welcome will be afforded to the Institute by Dr. V. Sykora, President of the Society of Czechoslovak Engineers, by his Excellency Dr. J. Matousek, Minister of Commerce, Industry and Trade, by Dr. K. Baxa, Lord Mayor of the City of Prague, and by Dr. A. Sonnenschein, managing director of the Vitkovice Mines, Steel and Ironworks Corporation, as representing the iron and steel industry. Papers Nos. 3, 7 and 2 are then expected to be read and discussed.

On the Tuesday the meeting will be resumed at 10 a.m., when papers Nos. 5, 11, 1 and 8 are expected to be read and discussed.

PERSONAL AND BUSINESS ANNOUNCEMENTS

THE BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION has secured a factory property, Regnart Buildings, Euston-street, London, N.W. 1, where it is proposed to centralise its offices and provide accommodation for a laboratory and workshops for its research and technical development departments. The Association has just enlarged its staff by appointing Mr. D. H. Ingall, D.Sc., as Assistant Director and Research Manager, to take effect from January next. Dr. O. F. Hudson will continue as Senior Metallurgist of the Association. Mr. G. L. Bailey, M.Sc., of the Metallurgy Section, Research Department, Woolwich, has been appointed from September 1st as Development Officer, to fill the position recently vacated by Mr. S. J. Nightingale.

CONTRACTS.

J. W. BROOKE AND CO., Ltd., of Lowestoft, have received an order for a 65ft. twin-screw motor houseboat for use chiefly on the Broads, though it is to be of such a substantial nature that it can be taken round to the Thames or the South Coast under escort.

J. AND F. HOWARD, Ltd., of Bedford, one of the associated firms of Agricultural and General Engineers, Ltd., have received an order from the Liverpool Corporation for the equipment of its new abattoir at Stanley. This abattoir will have a capacity for dealing with 1000 cattle, 900 calves, 7500 sheep, and 2000 pigs, a total of 11,400 animals a day.

THE CLARKSON THIMBLE TUBE BOILER COMPANY, Ltd., of 613, Australia House, Strand, London, W.C. 2, has recently fitted boiler installations and equipment of various types in the m.v. "Cementkarrier;" in a vessel belonging to the Com. Sud Amerika de Vapores; in "Ship 39" belonging to the East Asiatic Company, Ltd.; in the motor yacht "Virginia;" some tankers belonging to the German-American Petroleum Company; and in the "Silvercypress," "Silversandal," "Silverwalnut" and "Silverteak."

THE GREAT WESTERN RAILWAY has announced that the following orders have recently been placed :—(*a*) Widening the main line between Bentley Heath Level Crossing and Rowington Junction, 4½ miles, the Cleveland Bridge and Engineering Company, Ltd., Darlington; (*b*) the construction of two avoiding lines near Westbury and Frome, Logan and Hemingway, Doncaster; (*c*) the supply, delivery and erection of two fixed coal hoists for No. 1 Dock and two fixed coal hoists for No. 2 Dock at Barry, Vickers-Armstrong, Ltd., London; (*d*) the supply and erection of two fixed coal hoists at South Dock and two fixed coal hoists at Prince of Wales Dock at Swansea, the Hydraulic Engineering Company, Ltd., Chester; (*e*) the widening of the bridge over the river Taff in connection with Cardiff General Station alterations, A. Jackman and Son, Ltd., Slough; (*f*) the supply and erection of two fixed coal hoists for Port Talbot, the East Ferry Road Engineering Works Company, Ltd., London; (*g*) the renewal of a swing bridge over the Bute West Dock Lock at Cardiff, the Horseley Bridge and Engineering Company, Ltd., Darlington; (*h*) the construction of a retaining wall and other works for a new Parcels Depôt, Bishops Mews, at Paddington Station, Holliday and Greenwood, Ltd., London; (*i*) the steel work for use in connection with repairs and renewals to bridges, the Fairfield Shipbuilding and Engineering Company, Ltd., Chepstow; (*j*) repairs to the dredger "Don Federico," Chas. Hill and Son, Ltd., Bristol; (*k*) repairing, cleaning and painting the roof of No. 2 span at Paddington Station, C. and T. Painters, Ltd., London; (*l*) the erection of ten coal offices at Hall Green, Birmingham, Geo. Mobles, Hall Green; (*m*) new public and station footbridge at Cradley Heath and Cradley Station, Tildesley, Ltd., Darlaston; (*n*) repairing, cleaning and painting the roof of warehouse and riverside premises at Royal Victoria and Albert Dock, Edward Proctor and Sons, London; (*o*) the erection of stationmaster's house at Lydbrook Junction, E. J. Flewelling and Son, Lydbrook; (*p*) the renewal of platform decking to Nos. 2 and 4 platforms at South Lambeth, Wm. Walkerdine, Ltd., London; (*q*) the erection of two lattice main girders for an underbridge at Bilston W.M. Station Yard, Askham and Palin, London; and (*r*) re-covering the roof of a warehouse at Nag's Head Depôt, Borough High-street, S.E., Standard Flat Roofing Company, London.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast,	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	19/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 18 6	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 6 0	3 6 0
Siliceous Iron	3 6 0	3 6 0
No. 3 G.M.B.	3 3 6	3 3 6
No. 4 Foundry	3 2 6	3 2 6
No. 4 Forge	3 2 0	3 2 0
Mottled	3 1 6	3 1 6
White	3 1 6	3 1 6
Midlands—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 8 6	—
,, ,, Foundry	3 13 6	—
(c) Northampton—		
Foundry No. 3	3 10 0	—
Forge	3 5 0	—
Derbyshire—		
No. 3 Foundry	3 13 6	—
Forge	3 8 6	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (a) / 4 6 6 (b) / 4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
,, ,, (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	12 15 0	12 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 7 6	—
,, (Small Round)	7 17 6 to 8 0 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	9 15 0	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	9 15 0	—
Soft Wire Rods	8 0 0	—
Midlands—		
Small Rolled Bars	7 17 6 to 8 10 0	—
Billets and Sheet Bars	5 17 6 to 6 5 0	—
Galv. Sheets, f.o.b. L'pool	11 17 6	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/1½
Block Tin (cash)	135 0 0
,, (three months)	136 12 6
Copper (cash)	47 5 0
,, (three months)	47 6 3
Spanish Lead (cash)	18 7 6
,, ,, (three months)	18 3 9
Spelter (cash)	16 2 6
,, (three months)	16 12 6
Manchester—	
Copper, Best Selected Ingots	51 10 0
,, Electrolytic	52 0 0
,, Strong Sheets	79 0 0
,, Tubes (Basis Price), lb.	0 0 11½
Brass Tubes (Basis Price), lb.	0 0 10½
,, Condenser, lb.	0 1 0½
Lead, English	19 17 6
,, Foreign	18 2 6
Spelter	16 12 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 12 6	7/-
,, ,, 6 p.c. to 8 p.c.	£22 10 0	7/-
,, ,, 8 p.c. to 10 p.c.	£22 0 0	7/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 10 0	10/-
,, ,, ,, 1 p.c. carbon	£38 0 0	13/6
,, ,, ,, 0·70 p.c. carbon	£39 0 0	15/-
,, ,, ,, carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
,, ,, ,,	£11 0 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 7/- per unit	
,, Vanadium	12/9 per lb.	
,, Molybdenum	4/2 per lb.	
,, Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
,, ,, Ell	13/3
,, ,, Splint	14/- to 15/6
,, ,, Trebles	13/-
,, ,, Doubles	12/6 to 13/-
,, ,, Singles	11/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/3
,, ,, Jewel	16/-
,, ,, Trebles	13/-
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	10/9 to 12/-
Screened Navigation	16/6 to 17/6
Trebles	13/6
Doubles	12/6 to 13/-
Singles	11/6 to 12/-
Lothians—	
(f.o.b. Leith)—Best Steam	11/6
Secondary Steam	11/-
Trebles	12/6 to 13/-
Doubles	12/6
Singles	11/6 to 12/-

ENGLAND.

	Export.
(8) N.W. Coast—	
Steams	20/6 to 21/-
Household	32/- to 51/-
Coke	20/- to 21/-
Northumberland—	
Best Steams	13/6
Second Steams	12/-
Steam Smalls	10/- to 10/6
Unscreened	12/6
Household	25/- to 37/-
Durham—	
Best Gas	14/9 to 15/-
Second	12/9 to 13/-
Household	25/- to 37/-
Foundry Coke	24/- to 26/-

Sheffield—	Inland.
Best Hand-picked Branch	24/- to 25/6 —
Derbyshire Best Bright House	19/- to 21/- —
Best House Coal	18/- to 19/6 —
Screened House Coal	16/- to 17/- —
,, ,, Nuts	14/- to 16/- —
Yorkshire Hards	14/- to 15/6 —
Derbyshire Hards	14/- to 15/6 —
Rough Slacks	8/6 to 9/- —
Nutty Slacks	7/- to 8/- —
Smalls	3/- to 5/- —
Blast-furnace Coke (Inland)	15/6 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.	17/- to 18/6

(9) SOUTH WALES.

	Export.
Cardiff—	
Steam Coals:	
Best Smokeless Large	20/-
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/- to 18/3
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/6 to 17/-
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/6 to 13/-
Washed Nuts	19/- to 22/-
No. 3 Rhondda Large	20/- to 20/6
,, ,, Smalls	15/6 to 16/-
No. 2 ,, Large	17/- to 17/3
,, ,, Through	16/- to 16/6
,, ,, Smalls	14/- to 14/3
Foundry Coke (Export)	27/6 to 37/-
Furnace Coke (Export)	21/- to 21/6
Patent Fuel	22/-
Pitwood (ex ship)	27/3 to 27/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/6 to 31/6
Red Vein	23/6 to 27/-
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/6 to 27/6
Peas	20/- to 21/-
Breaker Duff	10/- to 10/6
Rubbly Culm	11/6 to 12/-
Steam Coals:	
Large	19/6 to 21/6
Seconds	18/- to 19/6
Smalls	12/- to 13/-
Cargo Through	15/6 to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country stations.

French Engineering Notes.

(From our Correspondent in Paris.)

Road Engineering.

SINCE it was found necessary to modify the methods of road construction in order to meet new traffic conditions, the work done has been largely of an experimental character, and all sorts of systems have been tried with a view to providing the best and most durable roads for motor vehicles. The old roads, which were regarded as the finest that could be made, were found wanting for the safe running of fast cars on account partly of their excessive camber, but now that surface tarring allows of water draining off more easily, the roads can be made flatter. The camber is therefore reduced, the roads widened, the radii of curves increased and the curves themselves banked, while wherever possible the road is straightened out. Parts of the new roads between Paris and the coast are almost perfect speedways. While, however, adapting the roads to motor traffic, engineers have to take into account the needs of country users, and tarred surfaces are not suitable for horse wagons. They are bad for the horses, and are cut up by the wheels. As there is some lack of uniformity in the methods of modern road-making, the Minister of Public Works has issued a circular summarising the points that should guide road engineers. On account of the improvement in motor cars, the maximum gradient may be increased from 8 to 10 per cent., and as a car is presumed to require a track of 3 m. for safe driving, the width of the road in the open country should be a multiple of that number, according to the traffic, with a minimum of 6 m. The minimum radius from the centre of the road for curves is 100 m., and that should be increased wherever possible. The camber, in the case of a tarred road 7 m. wide, should not be more than one-eightieth of the width. Where the horse traffic is heavy, special attention must be paid to the surface, which should have a reduced camber, and the tarred portion should be covered with suitable gravel, while on gradients it is suggested that other methods of surface treatment may be employed. Curves may be banked from 3 to 6 per cent. over the larger part of the road, rising to 8 per cent. on the outside. All shallow cross drains and ridges that at one time were regarded by local authorities as a useful means of keeping down the speed of cars are to be suppressed or attenuated as much as possible. The trees on each side of the road are to be whitewashed up to a certain height, as is already done in many cases, and, at bends, vegetation which may interfere with the view of the road must be cut down to a height of about 1 m. Finally, engineers are strongly advised, when making new roads, to straighten them out and avoid bends as much as possible.

Costs.

The monthly publication of indices of costs show that there is an increase in the prices of home produce and goods and a decline in the prices of produce and material imported, and these statistics are causing some anxiety to economists who regard them as an indication of the trend of things in this country. If minerals, metals, and foreign produce of all kinds are cheapening, while the prices of everything produced and made in the country are going up, there is obviously something wrong, and the way is left open for competition from abroad. Apart from the financial burdens, which are common to most countries, the chief trouble is to conciliate the interests of the manufacturing industries and agriculture, and those interests are often in conflict, for, while the manufacturing trades draw labour from the country with the offer of high wages, makers declare that they have to bear an unfair share of the charges that should fall more equitably on farmers. The policy of the State is to look after the interests of the agricultural community, which has by far the greatest influence, and agriculture is, moreover, the national industry. So bad were the conditions of the industry that Government adopted the bold measure of ensuring for growers a fair price for their grain, the result being that every advance in the price of wheat has been followed by a relatively greater rise in other products depending upon it. There is no reason for that except excessive intermediate profit taking. It affects the manufacturing industries which have to cope with increasing costs at a time when the prices of raw material have declined.

Paris Sewage.

The new Paris sewage scheme, which is amongst the biggest of its kind, will probably be put in hand next year, but it is by no means certain that the difficulties in the way of the project will be settled by then, for while it may be possible to overcome the opposition of the Seine and Oise Department to the construction of the sewer through its territory, there is the still more serious problem of extending the sewage farms at Achères. At present the volume of sewage collected in Paris daily is about 1,300,000 cubic metres, and it is estimated that within forty years the suburbs will have swollen the volume to 2,800,000 cubic metres. Already the farms are absorbing all the sewage they can. The local opposition to an extension of the farms is so strong that more attention is being given to bacterial and other methods of sewage treatment, and it is intended to install some works for that purpose, but the municipal engineers insist upon sending as much sewage as they can to the farms. As it is quite impossible to increase the capacity of the existing sewage system in Paris, the new scheme provides for the construction of collectors around the city. The sewers in Paris are used for electric cables and other mains. Those to be constructed around Paris will be employed solely for sewage. There will be separate sewers for diverting rain water into the river. One collector from Charenton to the Clichy decanting and pumping station will take all the sewage from the north-eastern and eastern suburbs. The sewage from the northern suburb will be sent directly from Saint-Denis to Achères; the southern suburbs will be served by a main that will follow the left bank of the Seine to Boulogne and on to Achères, while a branch sewer will follow the Seine in the opposite direction to the Place de la Concorde, where it will join the collector which goes to the Achères farm. The work will occupy about twenty years, and its cost is estimated at 3000 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

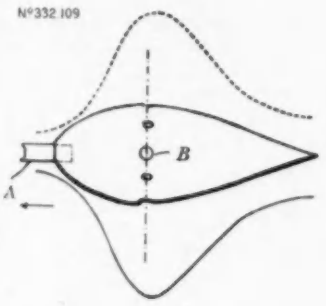
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

332,109. August 22nd, 1929.—SILENCERS, J. C. M. R. de Rigaut de Saint-Aubin, 66, Rue de Pomthien, Paris.

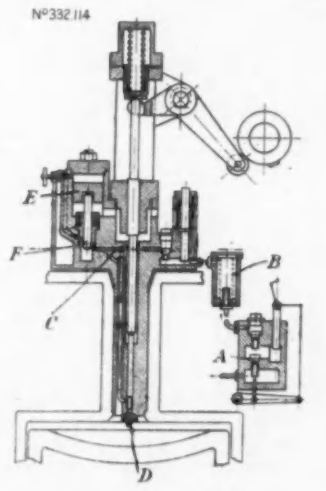
It would appear that the inventor aims at combining the offices of silencer and scavenger for an aeroplane engine in one piece. The silencer is made of "torpedo"-like form, as is shown



by the thick lines in the drawing, and is connected with the exhaust at A. The exhaust escapes from the silencer by the openings B, which are so arranged that they coincide with the minimum surrounding atmospheric pressure, as indicated by the dotted lines, produced by the forward movement of the silencer.—*July 17th*, 1930.

332,114. August 30th, 1929.—FUEL INJECTING DEVICES, P. Taragno, 29, Corso Tassoni, Turin, Italy, and Società Anonima per l'Impegio Razionale Degli Olii Combustibili "Ignea," 28, Corso Tassoni, Turin.

The essence of this invention is the supply of a charge of fuel

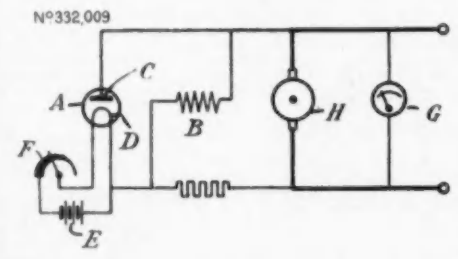


oil to each cylinder of an engine by means of a pump A, and through a filter B to a space C above the injection jet D. It is there subjected at the moment of injection to an increased pressure, which is produced by the piston E communicating with the gas space of the combustion chamber and the plunger F in the oil space.—*July 17th*, 1930.

DYNAMOS AND MOTORS.

332,009. June 1st, 1929.—ELECTRIC GENERATING INSTALLATIONS, *Stanley Gordon Sinclair Dicker, of 20 to 23, Holborn, London, E.C.* 1.

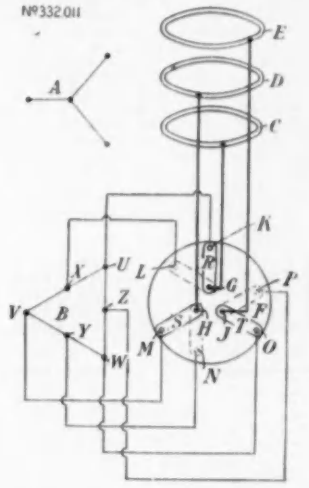
This invention relates to an electric generating installation, comprising a self-exciting dynamo-electric machine. The voltage of such a machine may be controlled by means of one



or more discharge tubes connected in parallel to the shunt winding of the machine. A diode A is connected in parallel to the field B, a tube containing an anode C and an incandescent cathode D. The latter obtains its heating current from a battery E, and the heating current can be regulated by means of a resistance F. If it is increased, the internal resistance, and hence the voltage across the winding B, decreases. Consequently, the exciting current will decrease and, therefore, the voltage of the machine, which is indicated by the voltmeter G, will decrease. Thus, by means of a small regulating resistance F of very low capacity the power of the machine H, which may be very high, can be regulated within wide limits. The principal advantage of the scheme seems to be the quick response of the discharge tube, and consequently rapid voltage regulation.—*July 17th*, 1930.

332,011. June 6th, 1929.—DYNAMO-ELECTRIC MACHINES, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2, and Robert Orsettich and Max Kahn, both of the General Electric Company, Ltd., Engineering Works, Witton, Birmingham.

This invention relates to induction motors of the kind having primary windings adapted to give different pole numbers and a wound rotor requiring different external connections for different conditions of operation of the motor. In the drawing the stator is provided with windings A for giving twice the number of poles when operating on the 50-cycle supply as when operating on the 25-cycle supply. The rotor is provided with a delta-connected winding B and a set of three slip rings C, D, and E is arranged near an end of the rotor shaft on the side of a bearing for the shaft remote from the rotor, whilst at the end of the shaft adjacent to the slip rings and on the shaft is mounted a terminal board F. Secured to the terminal board and projecting from

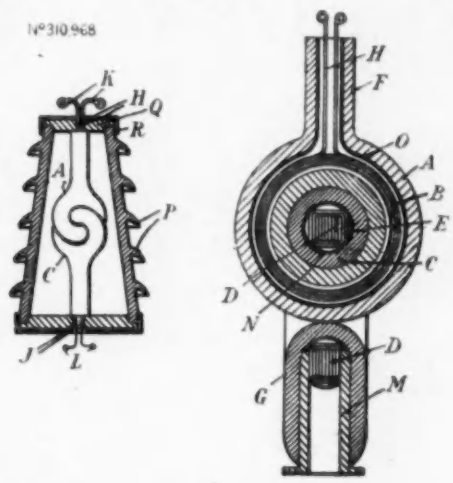


the front face are nine studs or screws, provided with clamping nuts, and a set of three studs G, H, and J near the centre of the board are respectively electrically connected with the three slip rings C, D, and E. The remaining studs are arranged nearer the periphery of the board and pairs of studs K and L, M and N, O and P are equally spaced from each of the three studs G, H, and J respectively with which the pairs of studs are severally associated. The studs K, M, and O form a second set, and the studs L, N, and P, a third set of studs, and only one of these sets is at a time operatively connected by means of three copper links R, S, and T with the first set of studs. The studs K, M, and O, moreover, are respectively electrically connected to the junction points U, V, and W of the delta connected windings B of the rotor, whilst the studs L, N, and P are respectively connected to the mid-points X, Y, and Z of the windings. The links R, S, and T are secured to the studs by clamping nuts and connect the studs G, H, and J, either with the studs K, M, and O—as shown in full lines—or with the studs L, N, and P—as shown in chain lines—and if it is desired to change from one frequency to the other frequency the rotor connections are correctly adjusted merely by changing the position of the links R, S, and T, so that instead of connecting together the studs G, H and J to one of the sets of studs K, M, O, and L, N, P, they connect together the studs G, H, and J to the other set of studs K, M, O or L, N, P, and this simple alteration may readily be made by unskilled labour.—*July 17th*, 1930.

TRANSFORMERS AND CONVERTERS.

310,968. May 1st, 1929.—INSULATION OF TRANSFORMERS, PARTICULARLY CROSS-RING TRANSFORMERS, Siemens and Halske Aktien-Gesellschaft, of Berlin-Siemensstadt, Germany.

The high potential insulation of cross ring transformers is generally so carried out that apart from insulating bodies between primary and secondary winding, the task of insulating is almost entirely directed to the insulating sleeve of the high potential winding. In particular, the primary windings in cross-ring transformers—that is, in which the two windings are inter-

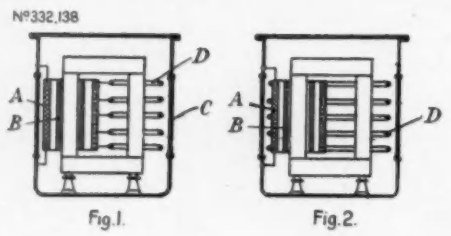


linked—have been so strongly surrounded by insulation that the core openings are entirely filled up, while the secondary windings have only been insulated as much as was necessary, with regard to the iron of the core. According to the invention, the insulating sleeves of both windings are made of equal strength; that is, of equal thickness. The hollow ring A, consisting of insulating material, surrounds the primary winding B. A similar hollow ring C surrounds the iron core D, with the secondary winding E wound thereon. Tube-shaped insulating projections F and G on these rings surround the extensions H and J of the winding ends carried to the terminals K and L. The carriers of the iron core D are indicated at M. The secondary winding E is sur-

rounded by a metal sleeve N, without corners or edges, conductively connected therewith, which prevents the injurious effects of the corners on the winding. The primary winding is protected in the same way by a sleeve O. It can be seen that the spark-over distance is increased in comparison with a transformer with insulation arranged on the high-tension winding only. When necessary, the projections F and G of the current transformer may have different lengths. By the partial relief of the primary winding from the insulation layer, its heat-dissipating property is improved. The quantity of insulation material is also reduced with the equal distribution on two rings on account of the smaller average radius. In order to avoid the disturbance of the field by surrounding metal masses, the housing P is preferably made entirely or largely of insulating material—for example, of ceramic substances. If the transformer is filled with oil, it is advisable, in order to avoid the difficulty of cementing ceramic material and metal, to effect the closing of the chamber by the cemented ceramic plates Q, and only to fix the metal caps R on them.—*July 17th*, 1930.

332,138. October 3rd, 1929.—HIGH-TENSION TRANSFORMERS, Aktiengesellschaft Brown, Boveri & Cie., of Baden, Switzerland.

This invention relates to a high-tension transformer with oil or compound insulation, without bushing insulators, and in which the high-tension terminals are arranged at the ends of a case shell of insulating material extending between the terminals over the length of the high-tension winding. The insulating shell must be of such dimensions that at its outer surface in contact with the air there can be no sparking over or creeping paths. According to the invention, this is effected by the potential distribution along the insulating shell being so controlled that, more especially at those parts lying opposite the core, there will be a more or less uniform potential drop.



The transformer consists in the ordinary way of the iron core, having two or more limbs with the concentric high and low-tension windings A and B, which are either wound on a single limb or are distributed over two limbs. The transformer is placed in the case filled with oil or compound insulation, the middle part C of which, in so far as it extends over the length of the high-tension winding, consists of insulating material, while the end parts serve as high-tension poles, and when the transformer is set up vertically, are made of iron, forming the bottom and cover. In transformers having a single-wound limb, the potential distribution is effected by open potential distribution rings D, which are connected to corresponding points of the high-tension winding and which surround either the unwound limb only—as shown in Fig. 1—or both the wound limb of the iron core as well—as shown in Fig. 2.—*July 17th*, 1930.

TRANSMISSION OF POWER.

332,177. December 21st, 1929.—ELECTRIC LEAD-SHEATHED CABLES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

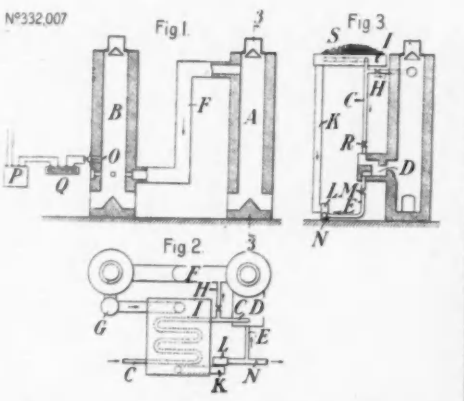
This invention relates to improvements in lead cables of a known type, in which the lead sheath is covered with metal strips of high tensile strength and elasticity. Through this binding, however, the cable has an increased tendency to expand longitudinally as its insulating compound becomes heated, and that brings about the well-known harmful consequences. Accord-

ing to the invention, the longitudinal tension is taken up by a second binding wound with a steep pitch, and in the same or in the opposite direction. Any detrimental longitudinal expansion of the cable is thereby prevented. The dimensions of the metal strips depend upon the longitudinal tension which has to be taken up. The steeply pitched binding preferably lies over the other binding. In the drawing, the cable provided with a lead sheath A is covered spirally with metal strips B of high tensile strength and elasticity. The binding B is covered by a multi-threaded and steeply pitched binding C, consisting of steel strips or wires of high tensile strength and elasticity.—*July 17th*, 1930.

GAS PRODUCERS.

332,007. May 30th, 1929.—THE MANUFACTURE OF PRODUCER GAS, The Reid Power Development Company, Ltd., 47, Victoria-street, London, S.W. 1, and J. W. Hinchley, 55, Radcliffe-road, London, S.W. 10.

The object of this invention is to make a producer gas contain-

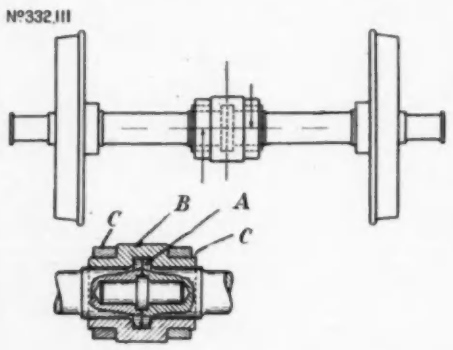


ing a larger proportion of carbon-monoxide than is usual. For this purpose the producer is worked in conjunction with a lime kiln and the carbon-dioxide coming from the kiln is fed into the producer. The kiln is worked at a temperature of about 650 deg. Cent., and the producer at 1000 deg. Cent. Fig. 1 is a vertical section through the lime kiln and the gas producer. Fig. 2 is a plan and Fig. 3 is a section on line 3–3 of Fig. 1. A is the lime kiln, H the producer. By means of a fan, not shown, air is blown through pipe C—Fig. 2—into the burner D of the lime kiln, where it meets producer gas proceeding from pipe E. Any excess air, the products of combustion and the liberated carbon dioxide pass from the lime kiln to the producer through pipe F, where they are joined by a portion of the air diverted, under control of a valve, from pipe C through pipe H. By passing a portion of the air through the pipe H, it may be possible on occasions to raise the temperature of the lime kiln. The gas produced in the producer passes from the upper part thereof through a dust catcher G into a box I. The latter contains a sinuous portion of the air pipe C, which is thus heated by the producer gas. The gas leaves the box I by a pipe K under suction of an auxiliary fan L, which forces a portion of it to the lime kiln through the pipe E under control of the valve M. The main portion of the gas proceeds to the gasholder by pipe N. The valve M is controlled by means of a pyrometer O in the gas producer, the particular device indicated diagrammatically in Fig. 1, comprising an electrical control unit Q controlling the circuit of the electrically-operated valve M actuated by an electric relay P. A similar device, not shown, is fitted in connection with the kiln A to control the valve R in the air pipe C. In Fig. 3 the heat exchange box I is shown as serving as a drying floor for the limestone S.—*July 17th*, 1930.

TRAMWAYS AND RAILWAYS.

332,111.—August 24th, 1929.—RAILWAY AXLES, M. F. Torazzi, Box 69, G.P.O., Vancouver, B.C.

In order to provide for the relative speeds of rotation of railway wheels, when rounding curves, the inventor cuts the axle in two at the centre of its length and provides each half with

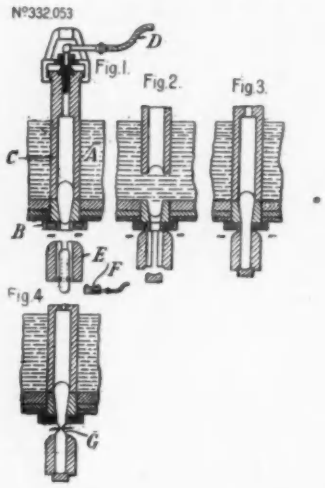


flanges A, which are embraced by a split sleeve B. This sleeve is held secure by two hoops C C shrunk in place. The two halves are also kept in alignment by a dowell. Reference is made in the specification to the lubrication of the relatively moving parts, but the means are not very plain.—*July 17th*, 1930.

MISCELLANEOUS.

332,053. July 9th, 1929.—GLASS-FEEDING APPARATUS, The United Glass Bottle Manufacturers, 40, Norfolk-street, Strand, London, W.C. 2, and T. C. Moorshead.

This glass-feeding device is of the combined gravity and suction type. A is the fore-hearth of the glass-melting furnace, which has a water-cooled orifice B. Inside the fore-hearth there is a refractory cylinder C, which can be reciprocated vertically. It is connected with a vacuum pump at D. Below the orifice B there is a gob former E, the bottom plate F of which



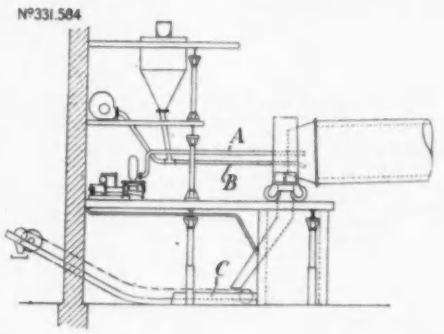
is also connected with the vacuum pump. As shown in Fig. 1 the gob former has just opened and is discharging a gob. In Fig. 2 the cylinder C has been raised to allow molten glass to enter, and such glass as it already contains is supported by the vacuum. The cylinder then descends, the gob former is closed, the vacuum above is destroyed and suction applied at the bottom plate F—see Fig. 3. The gob former descends and draws out a neck in the glass—see Fig. 4—which is severed by the shears G.—*July 17th*, 1930.

332,019. June 12th, 1929.—MERCURY ARC RECTIFIERS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Frank Percy Whitaker, of 237, Clifton-road, Rugby.

It has been found that the maximum load which mercury arc rectifiers can carry without risk of arc back is dependent on the pressure of the conducting vapour, which, in turn, depends on the temperature of the vacuum chamber of the rectifier. If the pressure and correspondingly the temperature are reduced below the optimum values the load which the rectifier can safely carry is lower than if the pressure and temperature were higher. It is therefore advantageous to provide means for preventing the rectifier from carrying such heavy loads at these temperatures. Overload relays which take into account the conditions of the apparatus as regards temperature as well as the degree of overload are well known for the protection of other classes of electrical apparatus, either by operating an alarm to draw the operator's attention to the dangerous state of affairs, or by starting up a reserve unit, switching in a load limiting resistance, disconnecting the apparatus concerned, or other suitable means. According to the invention, the rectifier is protected by an overload relay so designed that the current value at which it will operate is dependent not only on the current, but also on the temperature of the rectifier, the tripping current of the relay being lower when the temperature is below normal. One convenient way of effecting this dependence of the tripping current of the relay on temperature is to provide the overload relay with two settings, or to provide two overload relays, of any known type, with different current settings, in conjunction with a thermostatic switch on the rectifier which would change the relay over to the lower current setting or switch in only that relay that has the lower current setting, at times when the temperature of the rectifier falls below a predetermined value.—*July 17th*, 1930.

331,584. April 6th, 1929.—THE MANUFACTURE OF PORTLAND CEMENT, The British Portland Cement Manufacturers, Ltd., S. G. S. Panisset and W. S. Hannah, Portland House, Tothill-street, Westminster.

It is pointed out by the inventors that the presence of the higher oxides of such metals as iron, manganese and chromium



in Portland cement may spoil its colour, while the lower oxides will be innocuous. They, consequently, calcine the raw materials in a reducing atmosphere and then quickly cool them before they have time to re-oxidise. The kiln is heated, in the usual manner, by the oil burner A and powdered coal is sprayed on to the outcoming clinker through the duct B before the clinker has time to be re-oxidised as it passes to the collecting apparatus C.—*July 7th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY TO WEDNESDAY, SEPTEMBER 3RD TO 10TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Bristol meeting. The presidential address, by Professor F. O. Bower, will deal with "Size and Form in Plants." Evening discourses will be given by Professor E. V. Appleton, F.R.S., on "Wireless Echoes," and by Dr. R. E. Slade on "The Nitrogen Industry and our Food Supply." Evening receptions and excursions to points of scientific interest, works, &c., in the locality will be arranged.

THURSDAY TO SUNDAY, SEPTEMBER 4TH TO 7TH.

INTERNATIONAL CONGRESS OF CONSULTING ENGINEERS.—Fifth Congress at Vienna.

TUESDAY TO FRIDAY, SEPTEMBER 9TH TO 12TH.

INSTITUTE OF METALS.—Annual autumn meeting, Southampton. Continued from September 12th to September 16th by a visit to France. The meetings at Southampton will be held in the Chantry Hall, and on September 9th Professor D. Hanson will read a paper on "The Use of Non-ferrous Metals in the Aeronautical Industry." 8 p.m. For programme see page 82.

SATURDAY, SEPTEMBER 13TH, TO SATURDAY, SEPTEMBER 20TH.

LIVERPOOL.—Centenary celebrations of the Liverpool and Manchester Railway.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 17TH TO OCTOBER 1ST.

BUILDING TRADES EXHIBITION.—At Olympia, London.

SUNDAY TO WEDNESDAY, SEPTEMBER 14TH TO 17TH.

NEWCOMEN SOCIETY.—Summer meeting at Liverpool.

BRITISH-AFRICA INDUSTRIAL DEVELOPMENT EXPEDITION.—A motoring expedition which will leave England about the end of the year and will travel across Europe to Stamboul, through Asia Minor and Palestine to Egypt, and from there down through the heart of Africa to Cape Colony, is being organised by Mr. Geoffrey Malins. The journey of about 12,000 miles will be made with a convoy of British cars and one motor cycle "tender." The expedition has several objects in view, the first and foremost being to show that British products are the best; to demonstrate their value abroad; and to prove that British-built motors can travel anywhere that there is room for their wheels. Throughout the whole journey, every effort will be made to make public the fact that all the materials used on the expedition are British, and are especially suitable to the people of the countries through which the expedition passes. The convoy is to be accompanied throughout by a commercial manager, whose sole business it will be to make every attempt to advertise the goods along the route, to interview any who may be interested in them, give the fullest possible particulars, and, in fact, act as a personal salesman or representative of the firms concerned. He will, should it be wished, actually book orders and send them home, and in such case will make local inquiries as to the financial standing, &c., of the customer, and forward a confidential report on this to the seller. Films illustrating the items of British manufacture used on this journey will also be included in the programme. These films will be shown, and in most cases accompanied by a lecture, at not less than 100 centres.